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## NOVEMBER, 1927

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## CORRECTION

REVIEW, September, 1927:

Page 416, top line, first column, "*geographical*" should be "*geophysical*."

# MONTHLY WEATHER REVIEW

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NOVEMBER, 1927

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## WEATHER AND CORN MATURITY IN IOWA


By CHARLES D. REED

[Weather Bureau, Des Moines, Iowa, October 20, 1927]


There is a well-defined tendency for corn in Iowa to become more and more damaged by frost before it reaches maturity. What to do with the soft corn becomes a serious matter when the amount of such corn is greater than can be readily absorbed by feeding to animals. It is the purpose of this study to examine some of the possible weather and other causes of frosted corn.

For the period of 37 years, 1890–1926, inclusive, the long-time trend in yield of corn is upward at the rate of 0.28255 bushel per acre per year, calculated by the least square method. In the same period the corn that escaped frost damage has decreased at the rate of 0.549 per cent per year. These trends are shown by Figure 1. Dividing the maturity trend by the yield trend we get a decrease in maturity of 1.9 per cent for each bushel per acre increase in yield. In the 10 years, 1890–1899, 95 per cent of the corn on the average escaped frost, while in the last 10 years 80 per cent of the crop escaped, and in the last 5 years only 73 per cent. This scarcely leaves a doubt that the farmers of Iowa by breeding for large yields per acre have sacrificed maturity of the crop. Perhaps the yield might have been increased without sacrificing maturity, if maturity had been made a coobjective, but apparently this has not been done.

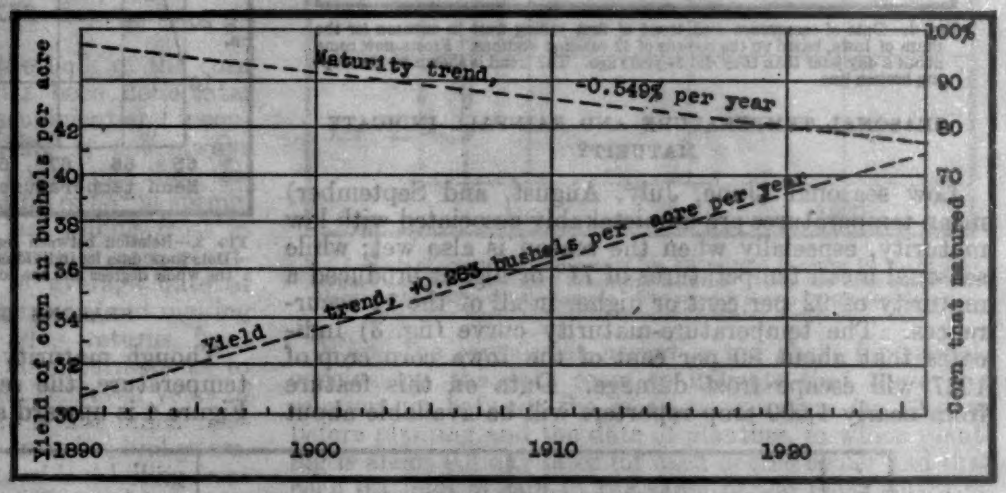


FIG. 1.—Trend of yield per acre and maturity of corn in Iowa

### TENDENCY TO LATER AUTUMN FROSTS [1]

Yet a question naturally arises as to whether the first killing frost in autumn has shown a tendency to become earlier. State-wide frost tables were not compiled until 1904 nor can a good distribution of stations be selected prior to 1893. Even the best cooperative observing stations have occasional breaks in their records. Stations in the growing cities and larger towns could not be used because the trend might be vitiated by city influences which are probably more potent in relation to the occurrence of frost than to most other meteorological phenomena.

However, a selection was made of 12 well-distributed stations having nearly complete records from 1893–1926. The stations selected were Rock Rapids, Algona, Alta, Mason City, Iowa Falls, Postville, Logan, Winterset, Clarinda, Iowa City, Oskaloosa, and Bonaparte. The average date of first killing frost or temperature of 32° F., or lower in autumn was computed for the 12 stations for each year. The general dependability of the data is shown by the fact that the average of these 34 yearly averages is October 4, which agrees closely with the average of about 135 records recently used in constructing revised frost maps of the State of Iowa. City stations were not included in the 135. In a few test years for which state-wide averages are available, the 12-station average differs slightly from the State average as might be expected, yet for the purpose of determining the long time trend it is believed that the 12 stations are as useful as the 100 stations, approximately, that have been maintained.

The autumn frost tendency for this 34-year period is to grow later at the very inappreciable rate of 0.0361 day (52 minutes) per year. This for practical purposes is negligible for it amounts to a total of only 1.16 days in the 34 years and would probably disappear if a record of sufficient length were available. But this trend serves the useful purpose of reassurance that the increase in frosted corn is not due to earlier autumn frosts. The average of individual years and the trend are graphically shown by Figure 2. It will be noted that the earliest State average frost in this period was September 20, 1896, 1916, and 1918, and the latest October 25, 1914. A study of rather meager data back to 1873 leads the writer to believe that the earliest general killing frost in

[1] The average of 107 stations was Oct. 4, but the 12-station averages were used for comparison because the average of the 107 stations was not available in 1915.

Iowa was on September 8–9, 1883. Practically no correlation exists between the average dates of first killing frost in autumn and the percentage of corn that escapes frost, though the data are not here presented.

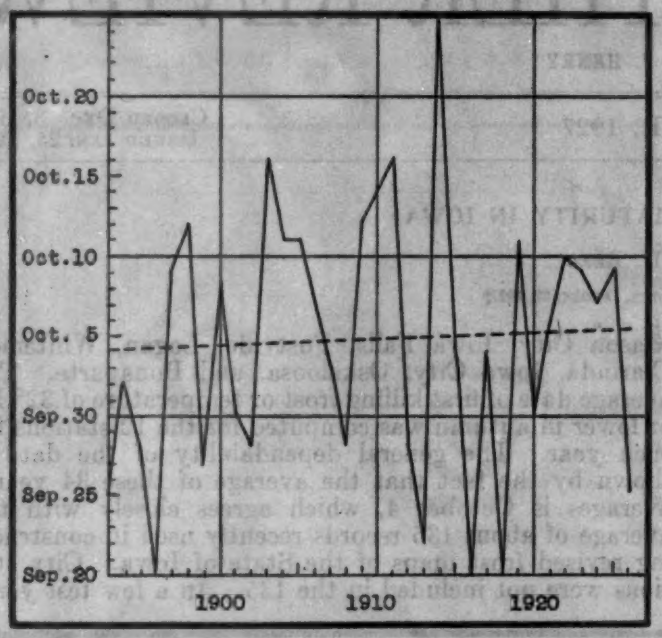


FIG. 2.—Date of occurrence and trend of first killing frost in autumn for the State of Iowa, based on the records of 12 selected stations. Frosts now come about a day later than they did 34 years ago. The trend is shown by the sloping broken line

## SEASONAL TEMPERATURE AND RAINFALL INDICATE MATURITY

Low seasonal (June, July, August, and September) mean temperatures are unmistakably associated with low maturity, especially when the season is also wet; while seasonal mean temperatures of 71° or higher produced a maturity of 92 per cent or higher in all of the 11 occurrences. The temperature-maturity curve (fig. 3) indicates that about 80 per cent of the Iowa corn crop of 1927 will escape frost damage. Data on this feature from nearly 1,000 crop reporters will be available about November 10. It will be interesting to see how the two compare. In general the percentage of corn that matures without frost damage decreases roughly at the rate of about 2½ per cent for each additional inch of rain during the season, though the relationship is better expressed by a more complex curvilinear formula, and at best it is not reliable because temperature is the more important factor.

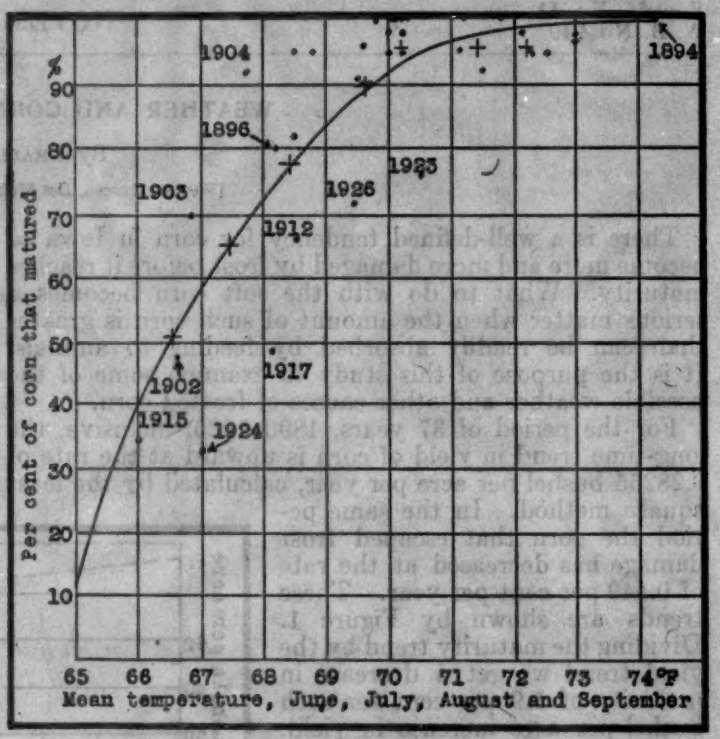


FIG. 3.—Relation between seasonal mean temperature and corn maturity in Iowa. Dots show data for individual years. Crosses show the average temperature between the whole degrees and the corresponding average maturity

## SEASONS GROWING SLIGHTLY WARMER

Though maturity is closely related to seasonal mean temperature, the seasonal temperature trend shown by Figure 4 is upward and therefore favorable, yet inappre-

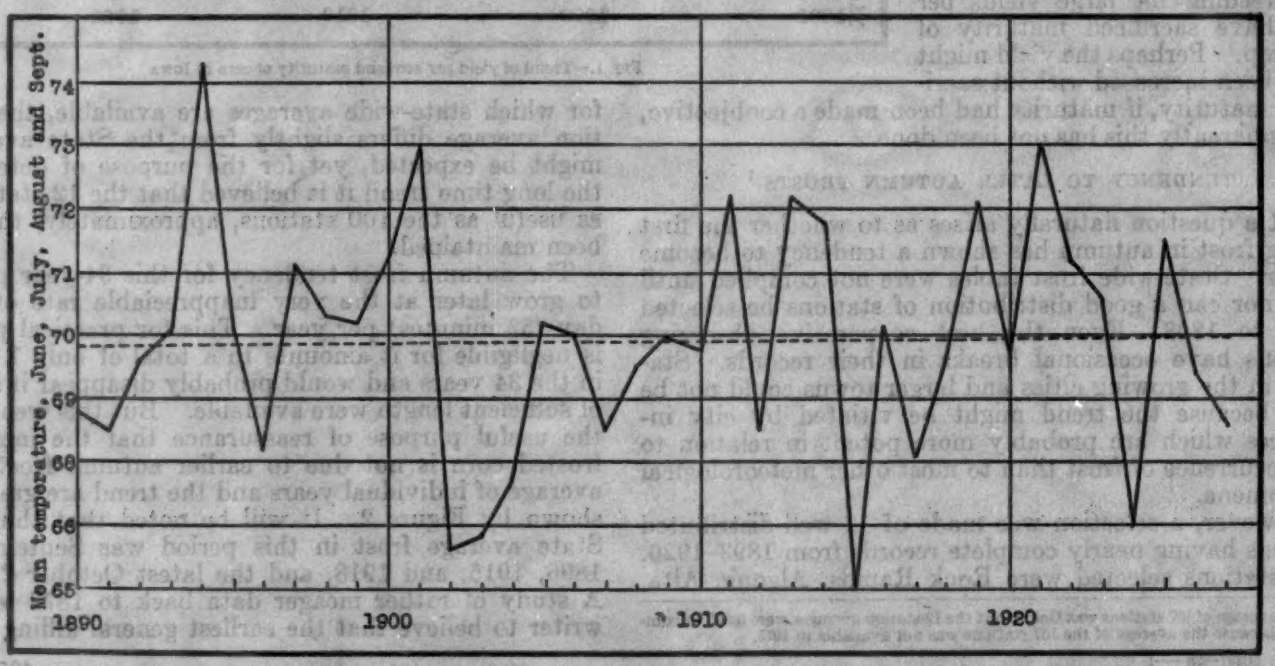


FIG. 4.—Iowa summers have shown a tendency to grow warmer at the inappreciable rate of 0.003° per year or a total change of 0.1° in 38 years. The sloping broken line shows this trend. In another such period this tendency might disappear

ciable, since it amounts to only 0.003° per year or a total of only 0.1° in 38 years and would probably disappear in a longer record. Therefore the increase in frosted corn can not be attributed to a tendency to cooler seasons. The coolest season in 38 years was 1915, with a mean temperature of 66°, and in that year only 35 per cent of the corn escaped frost though the average date of frost for the 12 selected stations was October 4, the same as the 37-year average. Ten other seasons out of 38 were cooler than 1927. Including only the three summer months—June, July, and August—the lowest mean was 66.8° in 1915; and five other seasons since 1890 were cooler than 1927. Including the five months, May to September, the mean of 1927 is 66.6°, and there are 10 colder periods out of 38. The frost damage of 1915 was surpassed only by that of 1924, when only 33 per cent of the crop escaped. The seasonal mean temperature of 1924 was 67°. Being 1° higher than in 1915, it should have resulted in more safe corn, but nine more years of effort to increase yields more than offset the more favorable temperature conditions. The average date of frost as shown by the 12 selected stations in 1924 was October 7,[1] or three days later than in 1915. The seasons 1902 and 1903 were cooler than 1924, but not so much corn was frosted, for the efforts to increase yield had not gone far at that time.

### CORN PLANTED LATER

There are some indications that the bulk of the corn planting in Iowa in recent years has been done later than formerly, though the data are insufficient and inconclusive; and furthermore late planting is not always followed by low maturity. Kincer points out the relation between the mean daily temperature of 55° in spring, the average date of occurrence of last killing frost in spring, and the average date of beginning of corn planting.[2] No data being available as to average date of planting the bulk of the corn the writer set about making an annual statistical inquiry, receiving returns from about 100 to nearly 300 well-distributed farmers as to the date of planting their "main fields." Seven years of these data are now available. There is not much relation between planting and frost date in individual years. For example, in 1925 the average date of last killing frost was May 24, the latest in the 35 years of record,[3] and the average date of planting that year was May 10, the earliest of the seven years, while in 1927 the average frost date was April 24 and the planting date was May 21, the latest of the seven years. However, the spring frost date trend shown by Figure 5 is to grow later at the rate of 0.2557 day per year or a total of about nine days in 35 years and if data were available as to date of planting the bulk of the crop, perhaps these might show a similar trend. The average date of last killing frost in spring for the State of Iowa is May 2 and on this date the statewide normal temperature is 55.3° which checks closely with Kincer's results.

The average date of planting "main fields" of corn in the seven years, 1921–1927, is May 14 and the average temperature of the 7 years on that date is 56.8°. The 46-year normal temperature on May 14 is 60.2°. The difference, 3.4°, may be some indication of the lateness of planting in the last seven years as compared with the average. The normal, 56.8°, comes about May 6, so the lateness of the last seven years would seem to be about eight days. As the total lateness of the frost trend is nine days, there seems to be a coincidence if not a relationship here. Like other weather trends, this tendency to late spring frosts will no doubt soon disappear and in any event its effect on corn maturity is not important.

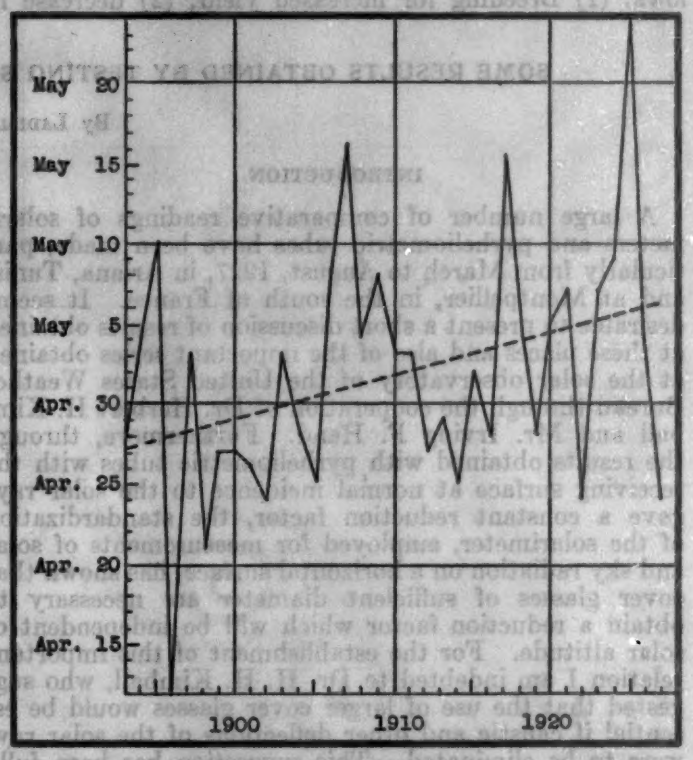


FIG. 5.—Date of occurrence and trend of last killing frost in spring for the State of Iowa, based on the records of 12 selected stations. Frosts now come about nine days later than they did 35 years ago. The trend is shown by the sloping broken line. In a longer record this tendency would probably disappear

While the seven-year period is too short for reliable conclusions, the data seem to indicate that there is a relationship between the mean temperature for 10 days before planting and the date of planting, in which planting is about 0.3 day later for each degree cooler and that each 0.1 inch of rain in the same period delays planting about 0.6 day. The mean temperature of the month of May for 38 years shows a very slight but inappreciable upward tendency, while the April tendency is about equally downward. Late planting sometimes results from rather remote causes. For example, the late planting in 1927 was mainly caused by the unprecedented rains of September, 1926, which saturated the soil to great depths, and by the rains of April, which were the heaviest April rains in 29 years, rather than from May weather conditions, which were not unusually abnormal. The temperature of the 10-day period preceding the average date of planting May 21, 1927, was 56.3°, which is only 0.3° lower than the average of the seven years. The rainfall in the 10-day period prior to planting was 0.2 inch below normal but the subsoil was saturated, it had no place to go, and it made the surface soil too wet for field work.

### PHOSPHORUS AND MATURITY

Another possible cause of increasing lateness in maturity that has been mentioned by some authors, is the continued removal of available phosphates from the soil

[1] The average of 107 stations was Oct. 4, but the 12-station averages were used for comparison because the average of the 107 stations was not available in 1915.
[2] MONTHLY WEATHER REVIEW, May, 1919, p. 315.
[3] Sections of Iowa were visited by a killing frost May 31, 1889, but it is impossible to strike a satisfactory State average with the data available in that year.

by cropping without much effort to replace the phosphates by the use of fertilizers. The value of phosphorus in hastening maturity is well known.

### CONCLUSIONS

Placed in the order of rank it is believed that the causes of the increase in frosted corn are about as follows: (1) Breeding for increased yield; (2) decrease in available phosphorus in the soil; (3) later planting due to later frost date and other unfavorable weather conditions. Slight but inappreciable tendencies that should have operated in the direction of improved maturity have been: (1) Later autumn frosts; (2) upward trend in seasonal temperature and also in the temperature of the month of May.

All weather tendencies will probably disappear when a sufficient length of record has accumulated.

## SOME RESULTS OBTAINED BY TESTING SOLARIMETERS WITH PYRHELIOMETRIC TUBES

By LADISLAUS GORCZYŃSKI

### INTRODUCTION

A large number of comparative readings of solarimeters and pyrheliometric tubes have been made, particularly from March to August, 1927, in Ariana, Tunis, and at Montpellier, in the south of France. It seems desirable to present a short discussion of results obtained at these places and also of the important series obtained at the solar observatory of the United States Weather Bureau through the cooperation of Dr. Herbert H. Kimball and Mr. Irving F. Hand. Furthermore, through the results obtained with pyrheliometric tubes with the receiving surface at normal incidence to the solar rays gave a constant reduction factor, the standardization of the solarimeter, employed for measurements of solar and sky radiation on a horizontal surface, has shown that cover glasses of sufficient diameter are necessary to obtain a reduction factor which will be independent of solar altitude. For the establishment of this important relation I am indebted to Dr. H. H. Kimball, who suggested that the use of larger cover glasses would be essential if caustic and other deflections of the solar rays were to be eliminated. This suggestion has been fully confirmed by the extensive series of measurements made at Montpellier.

In the following sections are presented the results obtained from comparative measurements of solarimeters and pyrheliometric tubes, and it is proven that by using cover glasses 50 millimeters in diameter and 1 millimeter thick the solarimeter coefficients are practically independent of the variable altitude of the sun. Results obtained with pyrheliometric tubes are also tabulated and indicate that the probable error of the reduction factor is small. Values of diffuse sky radiation are also tabulated.

### THE TESTING OF PYRHELIOMETER TUBES IN CONNECTION WITH SOLARIMETER BOXES

The pyrheliometer tubes are tested in connection with solarimeter boxes, the construction of which was described in my paper published in the September, 1926, REVIEW, 54:381–384. It will be recalled that the solarimeter is a small portable instrument for measuring solar radiation not only as received upon a horizontal surface but also by the addition of a pyrheliometric tube, the intensity of direct solar radiation at normal incidence. (See fig. 1.)

Using an equatorial mounting and a registering millivoltmeter, a pyrheliograph for automatic recording is easily obtained (fig. 2). The old-style register with inked pen and paper for only 24 hours has been replaced with a new recording millivoltmeter using typewriter ribbons and a continuous roll of paper, which provides for several days of record without attention.

Referring to my paper in the REVIEW for June, 1924, 52:299–301, Figures 1 and 2, it will be recalled that the thermopiles are made of thin plates of manganan and constantan of low resistance (about 8 ohms), with the active junctions arranged on a straight line in the center. In the newer type the thermoelements are covered with a special lacquer and form a rectangular surface without intervening spaces. This is important for horizontal exposure, as it avoids the varying influence of oblique solar rays. The pile is hermetically sealed in dry air under a cover of special flint glass. Those used in the pyrheliometric tubes are of similar construction but differ in the mounting. A sphero-cylindrical lens is generally placed in the outer end of the tube, thus obtaining about a fourfold magnification of intensity. The use of this lens is not obligatory, but it is useful in measuring low intensities, particularly when light filters are employed. An ordinary plain protecting glass is sufficient to obtain good deflections, which can be increased by using a more sensitive galvanometer. For our tests made in the south of France, mostly by my assistant, Mr. L. Lemanski, we have used a pyrheliometric tube with a plain glass. For the comparisons, simultaneous measurements were made with an Ångström electrical compensation pyrheliometer recently received and calibrated. The coefficient value (k) as determined by Doctor Bäcklin at the physical institute of the University of Upsala, Sweden, during the summer and autumn of 1926 was 14.9. The agreement is very good between this value, obtained by comparisons with Ångström's Standard No. 78, and the value

$$K = 60/4.19 \cdot r/b.\ a. = 14.93$$

where "r," the resistance = 0.2101, Ohm/cm, "b," the width of the strips = 0.2057 cm., and "a," the absorption coefficient = 0.98. For final computations, we have adopted, however, a coefficient value

$$k' = k \times 1.034 = 1.54$$

by adding the well-known correction for the border effect.

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(To face p. 489)

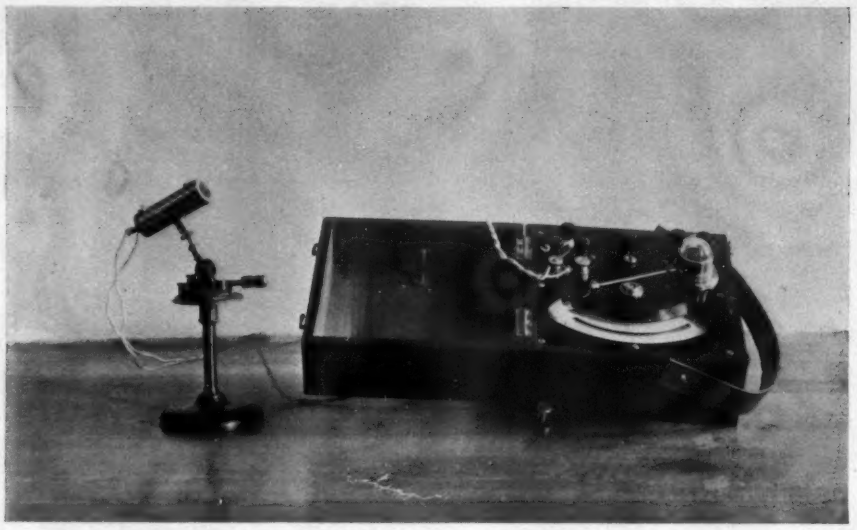


FIG. 1.—Pyrheliometric tube and solarimeter box

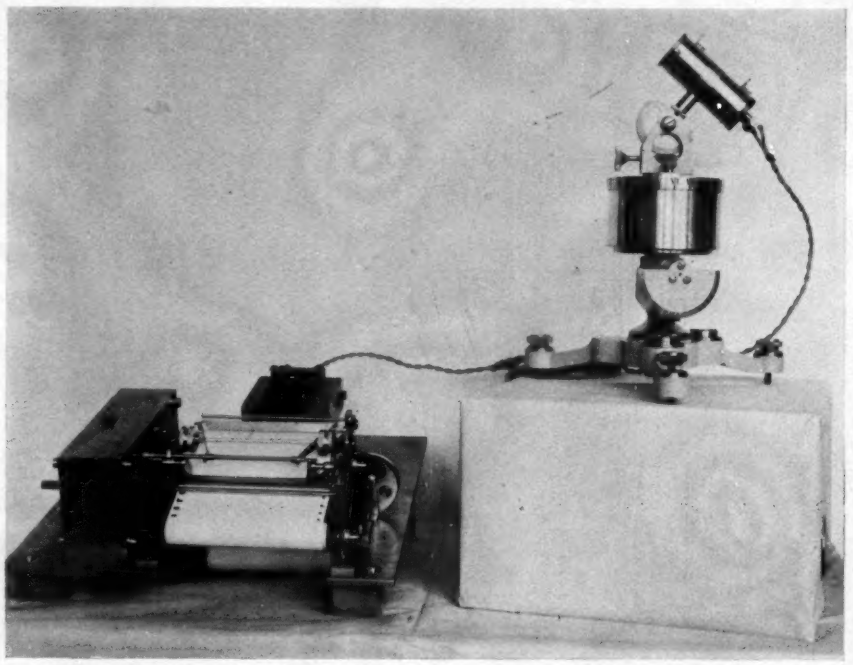


FIG. 2.—Pyrheliometric tube with equatorial mounting connected to a recording voltmeter

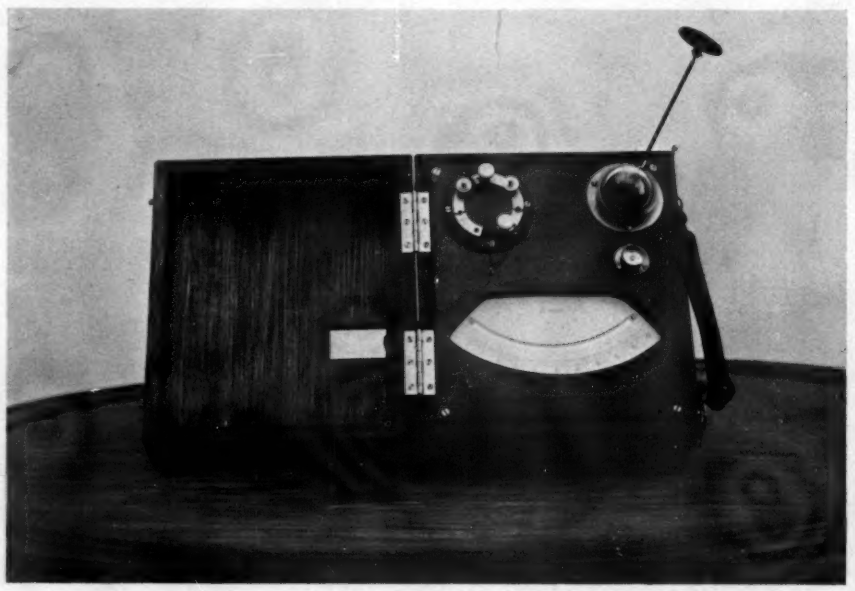


FIG. 3.—Solarimeter box with attached solar screen

*Reduction factor for a Gorczyński pyrheliometric tube normally exposed to sun's rays*

[Value of 1 scale division of millivoltmeter No. 4957 (gr. cal. cm.$^{-2}$ min.$^{-1}$)

| 1927 | Coefficient | 1927 | Coefficient |
|---|---|---|---|
| June 21 | 0.01567 | Aug. 8 | 0.01553 |
| June 22 | 579 | Aug. 10 | 560 |
| June 24 | 571 | Aug. 12 | 568 |
| June 28 | .01559 | Aug. 13 | 555 |
| July 1 | .01560 | Aug. 16 | 563 |
| July 5 | 575 | Aug. 17 | 563 |
| July 11 | 568 | Aug. 19 | 560 |
| July 12 | 557 | Aug. 20 | 562 |
| July 13 | 550 | Aug. 26 | 556 |
| July 14 | 553 | Aug. 27 | 563 |
| July 15 | 563 | Aug. 28 | 552 |
| July 17 | 561 | Aug. 31 | .01563 |
| July 18 | 546 | | |
| July 19 | 569 | | |
| July 20 | 546 | | |
| July 21 | 557 | | |
| July 30 | .01554 | | |
| Mean value | .01561 | Mean value | .01560 |

Table 1 shows the results of the comparisons between Ångström pyrheliometer No. 178 and our pyrheliometer tube mounted on a special holder and connected with a galvanometer (millivoltmeter No. 4957). We give the results of only 29 days during the period June–August, 1927, when these comparisons were particularly numerous and made during several hours every day. We add, however, that the mean coefficient value for our pyrheliometer tube obtained in 1926 and the first half of 1927 is in good accord with Table No. 1, showing a satisfactory constancy of the reduction factor, 0.0156, for different days and different altitudes of the sun.

The individual daily values are calculated as means of several (about 10) comparisons between the Ångström compensation pyrheliometer and our pyrheliometric tube. The daily reduction factors do not vary if the sky conditions are good; but clouds and foggy weather give greater departures, but even these do not exceed ±1 per cent. This is clearly shown by an example given in Table 2 on a day with very poor sky conditions.

TABLE 2.—*Example of variations in the coefficient value (reduction factor of the pyrheliometer tube connected with millivoltmeter No. 495F)*

[Montpellier, France, Aug. 26, 1927]

| Time | Gram-calories (Ångström pyrheliometer) | Pyrheliometer tube | | Sky condition (nebulosity) |
|---|---|---|---|---|
| | | Scale reading | Coefficient (f) | |
| h. m. | | | | |
| 6 42 | 0.66 | 42.6 | 0.0154 | Foggy (mist) and windy. |
| 7 04 | .84 | 54.0 | 156 | Do. |
| 7 31 | .94 | 60.3 | 156 | Neb. 3 veils. |
| 7 52 | 1.00 | 63.0 | 157 | Do. |
| 8 19 | 1.04 | 66.5 | 157 | Do. |
| 9 16 | 1.11 | 70.6 | 157 | Neb. 6 |
| 10 10 | 1.17 | 75.1 | 155 | Neb. 7 Frequent passages of clouds before the sun. |
| 10 39 | 1.19 | 76.9 | 155 | Neb. 8 |
| 11 09 | 1.18 | 76.2 | 155 | Neb. 9 |

N. B.—Very bad sky conditions in the morning hours. Frequent passages of clouds before noon. Sky covered (nebulosity 10) after 11 a. m.

To standardize a thermopile with its receiving surface exposed horizontally under a glass cover, as in the case of the solarimeter, it must be remembered that the pile receives scattered radiation from the sky as well as direct radiation from the sun, and that the effect of the glass cover must not be overlooked. In the REVIEW for August, 1914, 42 : 477, Figure 5, and for May, 1923, 51 : 241, Figure 4, Kimball has shown that by the use of a screen the radiation (S) received from the sky may be separated from the record of the total radiation (T). Then, to obtain the factor $F$, by which to reduce the solarimeter scale readings to heat units we have the equation

$$F=\frac{Q \sin h}{T-S}$$

where Q is the intensity of the solar radiation at normal incidence measured by a standard pyrheliometer, and h is the altitude of the sun at the time of the measurement. Example:

| | |
|---|---|
| Scale reading of solarimeter before exposure to sun and sky | 0.3 |
| Scale reading of solarimeter when exposed to sun | 46.5 |
| Scale reading of solarimeter with direct sunlight cut off by screen | 4.5 |
| Scale reading of solarimeter after exposure to sun and sky | 0.1 |
| Scale reading corresponding to radiation from sun and sky | 46.3 |
| Scale reading corresponding to radiation from sky | 4.3 |
| Scale reading corresponding to vertical component of radiation from the sun alone | 42.0 |

Solar radiation intensity at normal incidence 1.38 gr. cal. per min. per cm.$^2$, solar altitude 67.2°, sine 67.2°=0.922

$$F=\frac{1.38\times0.922}{42.0}=0.0303$$

Figure 3 shows a solarimeter with a solar screen so attached that it can always be made to shield the receiving surface of the thermopile from the direct rays of the sun.

Comparisons like the above made by Kimball and Hand at the American University, District of Columbia, showed that with glass covers of small diameters the value of $F$ varied with the altitude of the sun. The numerous comparisons made under the direction of the writer in Tunis and France confirmed their results, and showed, further, that the thickness of the glass as well as the diameter of the cover is a contributing factor to the variations.

In Table 3 are given the results of tests made with cover glasses of different diameters and thicknesses. The results are given for only a single day with each cover glass. They indicate that with cover glasses 50 millimeters in diameter or over and 1 millimeter thick there is no appreciable variation in the value of $F$ with variation in the solar altitude.

Table 4 includes all the tests made with cover glasses 50 millimeters in diameter and 1 millimeter thick; Table 5 the tests with cover glasses 40 millimeters in diameter and 1 millimeter and 2 millimeters thick; and Table 6 the tests with cover glasses 30 millimeters in diameter and 1 millimeter and 2 millimeters thick. These tests confirm what was shown in Table 3.

TABLE 3.—*Changes of solarimetric coefficients (reduction factors) for different sizes of glass-cover (in per cent of the value obtained at or near noon)*

| Diameters in centimeters (thickness in millimeters) | | Date | Sun's altitude | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 70° | 60° | 50° | 40° | 30° | 20° | 10° |
| Cm. | Mm. | 1927 | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| 100 | (1) | July 5, p. m. | 0 | 0 | 0 | 0 | 0 | +1 | ------ |
| 80 | (1) | Aug. 1, p. m. | ------ | 0 | 0 | 0 | 0 | 0 | ------ |
| 50 | (1) | Aug. 28, p. m. | ------ | ------ | 0 | 0 | +2 | 0 | −2 |
| 40 | (1) | July 25, p. m. | ------ | 0 | 0 | 0 | 0 | +1 | +4 |
| 40 | (2) | ------do------ | ------ | 0 | ------ | +3 | ------ | +10 | +18 |
| 38 | (2) | June 20, a. m. | ------ | 0 | +1 | +3 | +4 | +8 | ------ |
| 30 | (1) | ------do------ | ------ | 0 | +2 | +4 | +0 | +9 | ------ |
| 30 | (2) | June 21, a. m. | 0 | 0 | +1 | +3 | +0 | +19 | +21 |

TABLE 4.—*Changes of solarimetric coefficients (reduction factors) for a glass cover of 50 millimeters in diameter and 1 millimeter in thickness (in per cent of the value obtained at or near noon)*

| 1927 | Sun's altitude | | | | | | |
|---|---|---|---|---|---|---|---|
| | 70° | 60° | 50° | 40° | 30° | 20° | 10° |
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* |
| June 24, a. m. | 0 | +2 | +1 | −1 | −1 | ------- | ------- |
| June 24, p. m. | ------- | 0 | −2 | −1 | +1 | ------- | ------- |
| July 26, a. m. | 0 | +1 | +2 | +1 | −5 | −6 | ------- |
| July 30, a. m. | ------- | 0 | −2 | −5 | −7 | ------- | ------- |
| July 30, p. m. | ------- | 0 | ------- | ------- | −3 | −6 | ------- |
| Aug. 1, a. m. | ------- | 0 | ------- | ------- | −4 | ------- | ------- |
| Aug. 1, p. m. | ------- | ------- | 0 | −1 | ------- | +6 | ------- |
| Aug. 3, a. m. | ------- | 0 | 0 | +1 | 0 | ------- | ------- |
| Aug. 3, p. m. | ------- | ------- | 0 | −2 | +1 | ------- | ------- |
| Aug. 10, p. m. | ------- | ------- | 0 | 0 | +2 | +3 | +5 |
| Aug. 28, p. m. | ------- | ------- | 0 | 0 | +2 | 0 | −2 |
| Aug. 30, a. m. | ------- | 0 | 0 | −1 | −5 | ------- | ------- |
| Aug. 30, p. m. | ------- | 0 | 0 | +2 | ------- | +4 | ------- |
| Mean | ------- | ------- | ------- | −0.6 | −1.7 | +0.2 | (+1.5) |

TABLE 5.—*Changes of solarimetric coefficients (reduction factors) for a glass cover of 40 centimeters in diameter (in per cent of the value obtained at or near noon)*

A. DIAMETER, 40 CENTIMETERS; THICKNESS, 1 MILLIMETER

| 1927 | Sun's altitude | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 60° | 50° | 40° | 35° | 30° | 25° | 20° | 15° |
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* |
| July 24, p. m. | ------- | 0 | +1 | +3 | +5 | +8 | +11 | +14 |
| July 25, p. m. | ------- | 0 | 0 | 0 | 0 | +1 | +2 | ------- |
| Aug. 10, p. m. | ------- | ------- | 0 | −3 | −5 | −3 | −2 | −3 |
| Aug. 27, p. m. | ------- | 0 | 0 | 0 | −1 | −3 | −5 | ------- |
| Aug. 28, p. m. | ------- | 0 | 0 | 0 | 0 | −3 | −6 | ------- |

B. THE SAME DIAMETER; THICKNESS, 2 MILLIMETERS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| July 24, p. m. | ------- | 0 | 0 | +1 | +3 | +5 | +8 | +11 |
| July 25, p. m. | 0 | 0 | +2 | ------- | +5 | ------- | +10 | ------- |

TABLE 6.—*Increase of solarimetric coefficients (reduction factors) in function of sun's altitude for a glass cover of 30 centimeters in diameter (in per cent of the value obtained at or near noon)*

A. DIAMETER, 30 CENTIMETERS; THICKNESS, 2 MILLIMETERS

| 1927 | Sun's altitude | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 60° | 50° | 40° | 35° | 30° | 25° | 20° | 15° |
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* |
| Apr. 11 | ------- | ------- | 0 | 5 | ------- | ------- | ------- | 12 |
| Apr. 13 | ------- | ------- | 0 | 3 | 6 | 9 | ------- | ------- |
| Apr. 14 | ------- | 0 | 6 | 12 | 15 | 21 | 24 | 47 |
| Apr. 16 | ------- | ------- | 0 | 3 | 6 | 9 | 12 | 18 |
| Apr. 19 | ------- | 0 | 3 | 6 | 10 | ------- | ------- | ------- |
| Apr. 21 | ------- | 0 | 3 | 9 | 12 | 18 | 24 | 29 |
| Apr. 22 | ------- | 0 | 2 | 5 | 10 | ------- | ------- | ------- |
| June 6 | 0 | 4 | 8 | 10 | 12 | 15 | 21 | 35 |
| June 9 | 0 | 0 | 3 | 6 | 12 | ------- | ------- | ------- |
| June 21 | 0 | 0 | 3 | 6 | 9 | 12 | 18 | 25 |
| June 22 | 0 | 0 | 5 | 12 | 18 | ------- | ------- | ------- |
| June 24 | 0 | 0 | 8 | 14 | 18 | 26 | ------- | ------- |
| June 28 | 0 | 0 | 6 | 12 | 16 | 21 | 25 | ------- |
| Mean | ------- | ------- | 4 | 8 | 12 | 16 | 21 | 28 |

B. DIAMETER, 30 CENTIMETERS; THICKNESS, 1 MILLIMETER

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Apr. 18, a. m. | 0 | 0 | 0 | 0 | 3 | 6 | 9 | ------- |
| Apr. 18, p. m. | 0 | 1 | 3 | 6 | 9 | 12 | ------- | ------- |
| Apr. 20, a. m. | 0 | 3 | 6 | 9 | 10 | 13 | 15 | 18 |
| Apr. 20, p. m. | 0 | 3 | 6 | 9 | 12 | 18 | 21 | ------- |
| Apr. 21, a. m. | 0 | 0 | 0 | 0 | 0 | 0 | ------- | ------- |
| Apr. 21, p. m. | 0 | 0 | 3 | 4 | 5 | 6 | 9 | 18 |
| Apr. 18, p. m. | 0 | 3 | 10 | 12 | 14 | 16 | 18 | ------- |
| Mean | ------- | ------- | 4 | 6 | 8 | 10 | 14 | 18 |

In connection with these comparisons many measurements of sky radiation have been obtained. Expressed as a percentage of the total radiation (sun and sky) they show, in Table 7, a marked diurnal variation, with the maximum near noon. Table 8, which includes only midday measurements, gives a mean value for the period March 5 to August 30 of 10 per cent, with considerable variations in the values from day to day.

TABLE 7.—*Diurnal variation in the ratio* $\frac{\text{sky radiation}}{\text{solar radiation}}$, *expressed as a percentage*

| Hours | Per cent | Hours | Per cent |
|---|---|---|---|
| 11–13 | 12 | 6–7 | 24 |
| 13–16 | 12 | 7–8 | 17 |
| 16–17 | 20 | 8–9 | 13.5 |
| 17–18 | 28 | 9–11 | 12 |
| 18–18.30 | 39 | | |

TABLE 8.—*Minimum diurnal values of the diffuse sky radiation (generally observed between 11 and 13 hours)*

[After solarimetric measurements made at Montpellier, France (Mar. 28–Aug. 30) and Ariana, Tunis (Mar. 5 and 7)]

| 1927 | Per cent | 1927 | Per cent |
|---|---|---|---|
| Mar. 5 | 9 | June 16 | 19 |
| Mar. 7 | 13 | June 17 | 11 |
| Mar. 28 | 8 | June 18 | 12 |
| Mar. 30 | 9 | June 20 | 6 |
| Apr. 14 | 7 | June 21 | 6 |
| Apr. 19 | 10 | July 2 | 12 |
| Apr. 20 | 10 | July 5 | 8 |
| Apr. 21 | 10 | July 11 | 10 |
| Apr. 22 | 11 | July 12 | 10 |
| Apr. 26 | 8 | July 13 | 9 |
| May 1 | 9 | July 14 | 11 |
| May 11 | 13 | July 15 | 10 |
| May 12 | 13 | July 17 | 11 |
| May 13 | 12 | July 18 | 11 |
| May 14 | 9 | July 19 | 10 |
| May 23 | 13 | July 20 | 13 |
| May 24 | 9 | July 21 | 8 |
| May 25 | 9 | July 22 | 12 |
| May 28 | 11 | Aug. 27 | 14 |
| June 6 | 9 | Aug. 30 | 18 |
| June 7 | 8 | | |
| June 9 | 12 | Mean (March–August) | 10 |

## SUMMARY

In continuation of my paper on "Solarimeters and Solarigraphs" (MONTHLY WEATHER REVIEW, September, 1926, 54:381–384), it is here shown that, (1) a constant reduction factor is obtained from pyrheliometric tubes for extensive series of comparisons made at Ariana, Tunis, and Montpellier, France; (2) from solarimeter tests it is shown that, following a suggestion of Dr. H. H. Kimball, the coefficient values are independent of the solar altitude only when the cover glasses are of sufficient diameter; (3) that a cover glass 50 millimeters in diameter and 1 millimeter thick gives satisfactory results. Cover glasses 30 millimeters in diameter and 2 millimeters thick show an increase of 20 to 30 per cent (average values with clear sky) in the reduction factor with the sun near the horizon, as compared with the factor obtained with the sun near the zenith.

Some data for diffuse-sky radiation are given at the end of the paper.

## ON THE UNIT OF RADIATION[1]

By SIR NAPIER SHAW

[10 Moreton Gardens, London, S. W. 5, October 31, 1927]

The memorandum which has been communicated to the society by Doctor Simpson at Doctor Ångström's request was also communicated to me as president of the meteorological section of the International Union for Geodesy and Geophysics by Doctor Wallén, Director of the Meteorological and Hydrographical Institute of Sweden. It was intended for the meeting of the section which was held at Prague, September 3 to 10 of this year. Doctor Wallén asked that it should be printed in the minutes of the meeting although it had failed to reach him at Prague, and only reached me after my return to London.

I have asked the secretary to include it as an appendix to the report of the meeting. The subject of units only came before the section in the form of a resolution asking the bureau to make a report to a future meeting upon the unitary systems and practices of the sciences, geodesy, seismology, terrestrial magnetism and electricity, meteorology, oceanography, vulcanology and hydrology, the seven sciences which are included within the scope of the union. The conjunction of the seven in one union makes an inquiry of that kind possible and useful.

Doctor Ångström's memorandum does not refer to so wide a field; it concerns itself merely with kilowatts per square decameter which I have employed for radiation in many publications, including a summary of radiations all over the globe in the procès-verbaux of the meeting of Madrid in 1924. I have therefore supplemented his memorandum by a note which is intended to explain that no one could be more cordially in sympathy with Doctor Ångström's aspiration for uniformity of units for solar radiation (and every other physical quantity employed in meteorology) than myself. The difference between us is simply a question of how uniformity can most speedily be secured.

Policy will, I believe, be on my side, and history will bear me out in claiming that *a common system of units for the science* should be the first consideration of all those who are desirous of securing uniformity in units. Community of system is more important than uniformity in any single arbitrary unit. My preference for kilowatts per square decameter for radiation as compared with gram calories per square centimeter per minute or per day, is chiefly that the first belongs to a system based upon energy and its conservation, while the second is purely arbitrary. That there are other advantages I can easily show, but its place in a system is its chief recommendation. There must be many meteorologists who agree with me on that point.

Doctor Ångström would apparently regard the units adopted by the pioneers in any subject of measurement as binding upon the science for all time. With all respect for the pioneers I can not agree with that view, and I do not think other meteorologists can. It is too double-edged. Would anyone, for example, expect to be listened to now if he claimed that the units employed by G. S. Ohm in the enunciation of his law, or by Faraday in his experimental researches on electricity, were binding on physicists and chemists for all time? Does not the science of physics, and do not electricians all over the world, whether they are specially concerned for science or not, owe an immense debt of gratitude to Gauss, Maxwell, Kelvin, Fleming-Jenkin, and others who formulated a system of units which enabled students to interpret Ohm's measurements and Faraday's researches in systematic units? Where would electricity be now if systematic units had been vetoed in the middle of the last century in favor of the Daniell's cell or the Siemens unit of resistance?

And thereby may I hang a tale about the power of system in obtaining uniformity. The founders of systems of units had to conciliate opposition by framing two alternative *systems*, the foot-grain-second and the centimeter-gram-second. My earliest practice with measurements of terrestrial magnetism was in foot-grain-second units. British magneticians were prepared to accept a system but not one based on meters and grams. The foot-grain-second system is now only a memory and for magnetism and centimeter-gram-second system is universal.

My own prepossession in favor of systematic units for meteorology dates from 1910, when I became responsible for publishing other geophysical data with the meteorological output of my office, data for terrestrial magnetism in properly ordered centimentr-gram-second units and those for meteorology which up to that time had appeared in the happy-go-lucky units of the pioneers like the gram calorie per square centimeter per minute. I am apparently more subject to scientific nausea in circumstances of that kind than some of my colleagues; but it should be remembered that I spent 20 years of my life in instilling the principles of experimental physics into the studious youth at Cambridge, and this endeavor to be logical and reasonable about physical questions for 20 years has perhaps left its mark on my constitution.

I admit that the endeavor to convince meteorologists that a system of units is one of the primary requirements for progress in the science is not only arduous in itself, but is also faced with many discouragements. In the isolation of the presidential chair of an international meeting when one catches the suggestion of opinion from this side and from that upon subjects in which one is personally profoundly interested, systematic measurement is apt to carry the appearance of a hopeless quest. So many considerations which seem to be remote enter into the crystallization of opinion. And yet somehow, when the votes have been taken, systematic meteorology has secured surprising and almost unexpected successes. Quite recently at Leipzig systematic units repeated the triumph which they secured in London two years ago and that will continue. "I am personally in favor of it, but as representative I can not vote for it," was one form of opinion in 1925; there is less feeling of being thought too much in advance of the age now.

Much, of course, is owing to the work on Dynamic Meteorology and Hydrography by V. Bjerknes and his collaborators. It lays the foundations of systematic meteorology and the appeal of the work on that basis is, to me at least, irresistible. Some day I should like to translate some of its formularies in terms of temperature and entropy and bring into greater prominence the idea of temperature as the "velocity of mean square," but that will not injure its systematic nature.

[1] Angström, A. On the unit of radiation used in meteorological treatises on actinometry. MO. WEA. REVIEW, August, 1927, 55: 304.

Doctor Ångström applauds Mr. Dines's critical attitude toward kilowatts per square decameter, but what about a gram calorie per square centimeter per day? I will leave them to settle what exactly radiation expressed in gram calories per day may mean, I always have to look it up when I want to know; and also whether a minute or a day is more nearly in accordance with systematic scientific practice. It is the gram calorie which unites the opposition to a systematic unit, but here I am on safe ground. The gram calorie is surely a survival of the middle nineteenth century and is not suitable for the twentieth. It echoes a claim to express the total amount of heat as a product of the amount of water warmed and the rise of temperature produced. I happened to live a good deal of my academic life among people who were using electrical methods to determine the dynamical equivalent of heat, and one of the lessons I carried away was that to regard the specific heat of water as constant was to be behind the times. Of course, the difference does not matter much, but it is just that kind of precision which distinguishes and ought to distinguish the twentieth century from the nineteenth.

And the suggestion that raising the temperature of water by radiation finds practical application in nature leaves me quite cold. If the sun shines on the sea or moist earth to imagine the process as effectively limited to the warming of water or earth is really too crude for modern purposes. The concentration of solar radiation necessary to cook a chop is much more likely to be expressed in kilowatts per square decameter than in gram calories per square centimeter per minute. And in practice the kilowatt per square decameter is exceptionally convenient as a glance at my table of radiation in the procès-verbaux of Madrid will convince any impartial reader. It gives the solar constant in three figures about 145 without a decimal point. What more can one want?

I have heard it rumored that Doctor Abbot disapproves of kilowatts per square decameter as a unit for solar radiation. I wonder if those of us who are in favor of systematic measurements could persuade him that in this particular he is mistaken. His purpose, with which we all sympathize, will best be served by getting his measurments incorporated into everyday use in all the many sciences which are concerned with solar radiation. That will be the easier the more widespread the practice of using a systematic unit to express energy of any kind. In solar physics as in climatology so long as we are dealing only with geographical or chronological comparisons an unrelated arbitrary unit is as good as another; but when it comes to crossing scientific frontiers a negotiable unit is the best passport.

I am myself convinced that in a science like meteorology, which makes use of almost every other science under the sun, the passport of systematic units is an absolute necessity for progress. I may not live to see it, but the time can not be far distant when that principle will be recognized even by ministers for air, and as soon as they are systematized our units will have become also uniform.

The race this year was a contest among 15 teams representing eight countries; the presence on some of those teams of veteran balloonists and experienced meteorologists gave the rivalry a decidedly keen character in a sportsmanlike way.

As usual, interest became keen concerning weather on the day before, when affairs meteorological were shaping themselves for the race. The weather map, however, seemed cold to the interest of the race, and disclosed a condition of barometric flatness which was as baffling as it was latent in possibilities. Two outlooks could be held as promising; one would be toward a drift northeastward or eastward beset more or less by thundershowers; the other a slow drift south and southeastward behind the area of depressed barometers which was central over the lake-region.

On the 10th, the flat map had become a little more definite and at 8 a. m. a front of wind shift but mild temperature contrast could be delineated stretching southwestward from the LOW over Michigan. The situation recalls the 1922 Milwaukee balloon race when Westover, in a high-altitude drift, reached the wilds of Quebec, while the other ranking contestants took a low altitude drift and reached the region of Missouri. At Detroit, however, the sky never broke away its overcast long enough to permit even a fleeting glimpse of the upper clouds, and during most of the day an intermittent drizzle persisted, dulling the outlines of the lower clouds. So much depended on the position of the wind-shift line at the time of the take-off, that only by conceiving two definite plans of flight could the balloonists be sure of adopting successful tactics. If the line had reached Detroit when the starting hour arrived no alternative would be available than to ride out the slow but persistent winds of the front edge of the "polar" front; but if Detroit had still been in the warmer side of the LOW a drift eastward or eastnortheastward would have been worth adopting.

The take-off actually took place about two hours behind the passage of the wind shift, although no abrupt or marked change in the sky, wind, or temperature occurred with this passage, as indicated in part by Table 1. The chance for a brilliant coup at high altitudes was definitely lost to the certainty that rigid economy of ballast and gas, expert maneuvering against time, and a careful selection of altitude to obtain the fastest motion, would make up the elements of triumph.

# METEOROLOGICAL ASPECTS OF THE INTERNATIONAL BALLOON RACE, FROM DETROIT, MICH., SEPTEMBER 10, 1927

By C. G. ANDRUS

[Weather Bureau, New York]

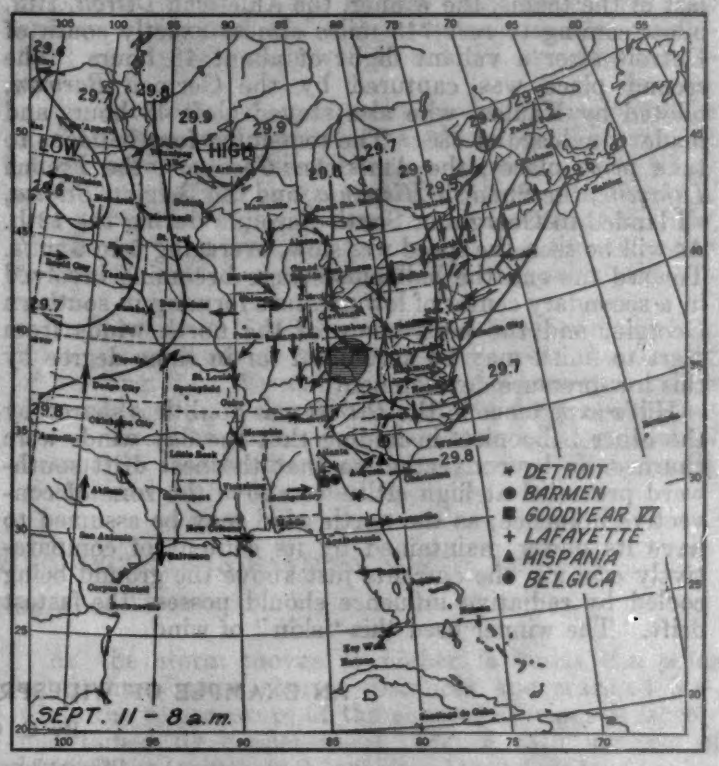
TABLE 1.—*Surface wind at Detroit, Mich., September 10, 1927*

| | Miles per hour | | Miles per hour |
|---|---|---|---|
| 7 a. m., SW | 3 | 2 p. m., WNW | 7 |
| 8 a. m., SW | 5 | 3 p. m., W | 5 |
| 9 a. m., SW | 5 | 4 p. m., W | 5 |
| 10 a. m., SW | 5 | 5 p. m., NW | 6 |
| 11 a. m., SW | 8 | 6 p. m., NW | 5 |
| 12 m., WSW | 9 | 7 p. m., N | 4 |
| 1 p. m., W | 7 | | |

The balloons took off between 3 p. m. and 5 p. m.

The position of the group of aeronauts at 8 p. m. of the 10th was close to the wind-shift line, but within the north-wind zone. So close to the line were the balloons known to be that advices by radio were drawn up to discuss the current conditions and outlook for positions in front of and behind the line of wind-shift. The LOW had now developed more force and the south to southwest winds on its front more vigor especially over eastern Pennsylvania and New York. In the rear a narrow but well-defined zone of winds solid in direction to an altitude of 10,000 feet was located, directed toward the SSE.

For the first time in such a race, the idea of giving the balloonists not merely the ground meteorologist's notion as to what was going on and what should be the airman's tactics, but also giving them a description of the barometric lines and the wind and weather change areas, was given trial, and from this broadcast by the radio station WJR at Detroit, the balloonists were enabled to do their own thinking on plans for success. The radio now forms an essential, and the drawing of a weather map in the basket of a racing balloon should become no more novel than the charting of barometric lines in the chart room of an ocean liner.




The race during the 11th was a continuation of the southward drift, the balloons striving to avail themselves of the best of the slow-moving streams of air in the area still just behind the wind-shift line. Convection with its instability took its toll and the attendant expenditure of ballast and gas brought several of the

balloonists to ground in western Virginia and North Carolina. The persistency of this northerly wind zone was one of the outstanding developments of the race, meteorologically speaking.

The next day, the 12th, witnessed the landing of the last of the teams, the winner, the American *Detroit*, Hill, pilot, coming to rest 745 miles almost exactly south of Detroit after a valiant flight of about 48 hours. The second place was captured by the German *Barman*, piloted by Kaulen, who also stayed aloft 48 hours and made a mileage of 688. The remaining four balloons to take prize places, the American *Goodyear*, the French *Lafayette*, the Spanish *Hispania*, and the Belgian *Belgica*, all landed in Georgia or South Carolina during the 12th. As will be seen the speed was slow, averaging 5 to 6 m./s. Toward the end the balloonists were becoming involved in a secondary center of low pressure forming in southern Georgia, and the persistency of the north winds from start to finish may be accounted for in some degree by this low-pressure development.

Hill's experience in the *Detroit* was doubtless shared by the other balloonists in finding that the day winds were churned up by convection so that the best drift southward prevailed at high altitudes above the zone of convective influence; as the north wind may be assumed to have its power maintained by its content of comparatively cool air, the currents just above the ground being cooled by radiative influence should possess the fastest drift. The winner used this "skin" of wind.

Convective activity with its adiabatic vertical temperature gradient means a busy time aboard a balloon, which can never be in equilibrium long while within such a condition and is usually bent on taking either a rapid descent or ascent; if left unchecked, this will result in accelerated vertical motion, which will mean a greater expenditure of ballast or gas. During the 11th and 12th the balloonists found daytime conditions of this sort, developed by sunshine.

Electrical storm activity was more threatening than real, and after the first night the zone of thunderstorms appears to have been located ahead of the balloons and at its worst to have been marked by storms developed more by unstable temperatures than by displaced moisture, and consequently less severe. The weather except at the start was mostly satisfactorily fair and little blind flying was done.

The outcome of the race testifies to the limited nature of the possible courses of action. All the balloons, but one which was disabled over Lake Erie, landed a short distance south of the Appalachian ridges in the Carolinas and Georgia. The similarity of courses and velocities of travel are conclusive evidence that all were playing the same aerial game. Fortunately, neither the sea nor severe weather forced any of them down, while the results speak eloquently of careful ballast economy and persistent search for the best wind streams over a period of time which tried both patience and endurance.

## AN EXAMPLE OF WIDESPREAD BUMPINESS IN THE AI

By C. G. ANDRUS

[Weather Bureau office, New York]

Airplane flights over the New York–Cleveland airway October 12, 1927, encountered extraordinary roughness on the air. Roughness, or, as sometimes called, bumpiness, in varying degrees of severity is commonly met but evokes little comment from seasoned aviators unless its intensity becomes a decided handicap in flight. Usually when it is severe it is local, frequently associated with line squalls, tornadoes, violent thunderstorms, or gales upturned by mountain ridges. Inasmuch as the roughness of October 12 extended over about 350 miles of a strip of territory and for more than six hours, it is believed to deserve a brief note.

Pilot Collins arrived at Hadley Airport in the forenoon, after a rough journey from Cleveland, in which he found the rain to be rapidly on the increase both in severity and extent over that which had been reported before he left; the air was moist and warm at moderate altitudes, and within areas of condensation the turbulence was plainly indicated by roughness. At noon he reversed his plane's course, taking off for Cleveland with weather reports which granted a meager amount of ceiling and visibility, a generous supply of rain, and a boisterous SE. and SSE. wind along the course. He landed at the Bellefonte, Pa., landing field at 1:50 p. m., reporting impossble weather for immediate continuation of the flight owing to low ceiling, rain, and severe rough air. He states that the roughness was the worst of his experience, and that it occurred not only just above the ridges but in an even worse manner within the clouds which were outpouring rain one to four thousand feet above the 2,500 feet of the Allegheny Mountains. Tossed about by vertical currents which carried the plane through sudden variations in altitude of more than 1,500 feet, the pilot found it difficult and exhausting to maintain either course or control, so that blind flying became more perilous than usual, for once within the opaque confines of the cloud masses great "bumps" and "pockets" would have separated pilot and plane had he not been belted down.

At the same time another pilot guiding the east-bound mail plane was struggling with the same hazards. During moments when the plane was first on one end and then on the other the altimeter would record tremenduous fluctuations in altitude; running into a heavy rain-squall cloud whose base would be 3,000 feet above sea level, he would be tossed up to 6,000, and while pointing the plane nose down with an air speed of 140 miles per hour would hover there, finally emerging from the cloud into another mass of air in a down current almost as violent. Dodging around such volcanoes of rain, cloud, and air over a sea of mountains and valleys such as in central Pennsylvania is a hazardous practice, and this pilot, H. G. Smith, sought relief in a stop at the Snowshoe, Pa., landing field. Although belted to their seats, both pilots were so thrown about and against their cockpits that they were sore and bruised. The difficulty of keeping their craft pointed in any one direction for a moment at a time has a semblance to the experience of mariners aboard craft which are wallowing in the seas near the eyes of hurricanes; maintaining safe altitude is, however, an added requirement.

An analysis of the conditions from which this roughness arose shows that an unusual combination of two factors provocative of vertical components within air masses was evidently in action. The generation of roughness results from either mechanical or thermodynamical forces; the former are actuated by topographic unevenness which deflects either up or down air passing

rapidly over it; the latter operates to give vertical motion or component or velocity to air masses which are potentially unstable. Such unstable air may be found in a dry condition in adiabatic convection resulting from overheating at the base or supercooling at the upper levels, or in a condensation condition within clouds which are the scene for the making of rain or snow and therefore characterized by potential temperatures which may be highly unstable; and another variety is reported by airmen to exist within a thin waferlike stratum of air which appears to act as a friction zone between wind drifts sometimes high aloft containing air of radically different velocities and temperatures, usually and perhaps always with the warmer on top.

From which source did the roughness of October 12 come? The reports point clearly to excessive condensation, and the pilots affirm the presence of the worst roughness within the clouds; the conclusion urged upon us is that the condensation-convection process was violent here. The weather map of 8 a. m. shows a $\frac{6}{10}$-inch barometric gradient across the 400-mile airways. The isobars run NNE.–SSW. and across them [1] races a 20 to 40 mile per hour SE. wind bearing heavy burden of sea-source air. Up to 7,500 feet the wind veered but slightly and increased in velocity. Temperatures were unseasonably high and moisture kept equal pace. A secondary formation in the lower end of a trough of low pressure extending to northwest Florida may have been one agency which held the east component in the circulation; at any rate such widespread SE. wind is uncommon.

The mountain effect on swift-moving air may well be the other source, for with increased horizontal movement comes increased vertical components when such winds climb up and roll down the hills. Too, the ridges in this particular region generally are directed NE.–SW., or nearly transverse to the motion of the air, with the result that it was turned the more abruptly upward.

On November 17, 1927, at about 6 p. m., a mail-plane pilot met with severe bumpiness while over the vicinity of Reading, Pa. A small but severe wind squall, possibly a tornado, occurred northeast of Reading about that time. The bumpiness was less extensive than that of October 12 (as were the contributing causes), but equally violent and probably of similar origin.

[1] The author refers, of course, to surface winds; the gradient winds, say, above 1,500 feet, undoubtedly had a southerly component and thus a direction more nearly parallel with the direction of the isobars.—ED.

## THE GROWTH OF THE NORTHEASTWARD-MOVING CYCLONE IN EASTERN NORTH AMERICA

By W. J. HUMPHREYS

It is a well-known fact that many cyclonic storms greatly increase in size and intensity as they move with a northward component across the United States east of the Mississippi River and over eastern Canada, or along the Atlantic coast. This development of the cyclone with increase of latitude is less marked in most other parts of the world, and in many places practically, if not quite, nonexistent.

Naturally, one might suspect that this marked development is somehow caused by the increase, with increased latitude, of the "deflective force" due to earth rotation. But this force increases by less than 25 per cent as the storm passes from latitude 35° to 45°, for instance, a quantity which, when we take into account, as we must, the cyclostrophic effect, would require only small changes of isobars or wind velocity, and not the great changes that so often occur in eastern North America and on the western Atlantic. Besides, this latitude effect is common to all parts of the earth, while the great growth of the cyclone with increase of latitude is not. The rapid increase in extent and intensity of the northeastward-moving cyclone in the region mentioned must, therefore, depend chiefly on some other cause than the incidental increase of earth deflection.

That cause is suggested by the structure of the extratropical cyclone and the topography of North America. That is, this storm, essentially a swirling passage by each other of a broad and relatively cold polar wind to the west and north, and an equally broad, warm equatorial wind to the south and east, necessarily varies with the contrast in temperature between the two currents and the availability of the air supplies.

As the storm moves to higher latitudes the polar winds have come shorter distances and warmed less, while the temperature of the equatorial winds is largely maintained by condensation. Hence with increase of latitude the temperature contrast of the winds tends to become greater, and therefore the winds stronger if the supply of each current is ample. Now, in the eastern United States and Canada and over the western Atlantic cyclonic storms often move rapidly northeastward, thus increasing the temperature contrasts; and in this region also there is free access, without mountain barrier, to cold air (especially in winter and spring) all the way to the Arctic Ocean. Furthermore, substantially the whole of this vast reservoir is on land and ice, hence its air is very cold. Similarly, the access here to the warm air from the Gulf of Mexico and Atlantic Ocean also is very easy and the air quite humid.

In short, over the region in question cyclones often move northeastward rapidly and increase in temperature contrast, while both the warm and the cold branches of the circulation are but little obstructed and from "inexhaustible" supplies. Such storms, therefore, increase with increase of latitude.

In most other parts of the world the opportunities for increasing temperature contrast between the two portions, polar and equatorial, of the cyclone are not so great, nor the air currents so free from obstruction and from such vast reservoirs. Hence the poleward-moving cyclone grows faster and to a greater extent in eastern North America and over the western Atlantic than in almost any other portion of the world.

## THE GREATER INCREASE IN SIZE AND INTENSITY OF THE EXTRATROPICAL CYCLONE BY NIGHT THAN BY DAY

W. J. HUMPHREYS

Mr. C. L. Mitchell, of the United States Weather Bureau, has called my attention to the interesting fact that winter cyclones moving northeastward in the United States, and doubtless similar storms also in other parts of the world, increase in size and intensity more rapidly by night than by day. Perhaps this phenomenon and its explanation are well known, but even so a repetition, if it be a repetition, of its brief explanation may be in order, for surely it is not very widely known.

In general, as everyone knows, the cool section of a cyclonic area is relatively clear and the warm section cloudy. At night, therefore, the clear section gets colder, or at least colder than it otherwise would be, owing to the great net loss of heat from the surface by radiation, while the clouded side more nearly maintains its temperature. During the daytime, on the other hand, the clear side warms up by insolation while the clouded portion again changes in temperature but little. That is, during the night the temperature contrast between the warm and the cool portions of the cyclone becomes or tends to become more and more pronounced and during the day less and less so. Furthermore, there is greater interference to the flow of the colder air during the daytime, owing to the thermal convection caused by insolation, than at night when there is no such convection. Hence, owing to the greater temperature contrast at night than during the day, and less obstruction to wind movement the cyclone normally grows, or tends to grow, more rapidly at night than during the day.

## NOVEMBER FLOODS IN NEW ENGLAND AND EASTERN NEW YORK

By H. C. FRANKENFIELD

*The New England and eastern New York floods.*—On the morning of November 3, 1927, pressure was quite low over Virginia and the Carolinas, while an increasing high pressure area was off the southeast coast of Newfoundland. Twelve hours later the center of the storm was just off the coast of New Jersey, with sea-level pressure of 29.32 inches, while the high pressure area to the northeastward had also increased in magnitude. It happened that the pressure development and distribution during the night of November 2 had been ideal for the occurrence of heavy precipitation. This, however, did not become apparent until the morning of November 3, and by the evening of that date torrential rains had fallen over eastern New York and western New England.

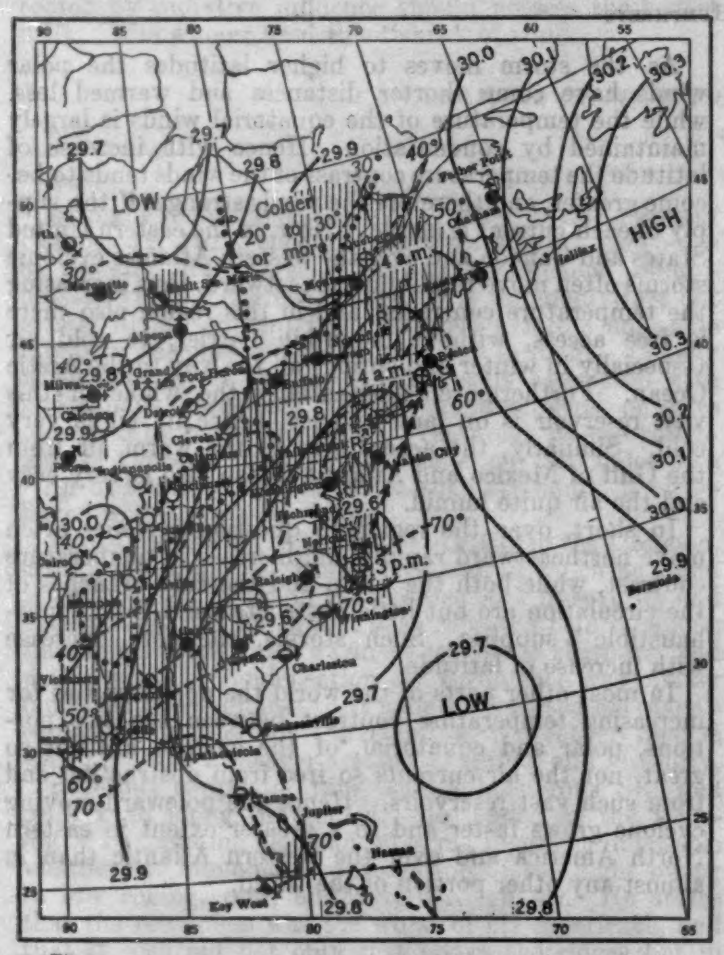



FIG. 1.—Weather conditions east of the Mississippi at 8 a. m. (eastern standard time) Two storm centers are shown on the 4th

The pressure distribution at 8 a. m., seventy-fifth meridian time on November 3, is shown in Figure 1. At that time a great barometric depression was centered over the Carolinas with local centers of relatively low pressure over the adjacent waters of the Atlantic and also north of the lower Lakes. By the next morning these several centers had consolidated, a northeastward movement had taken place with the result that there was now a single large depression of the barometer that stretched from the vicinity of Montreal to the Atlantic off the southern New England coast. Coincidently with this consolidation and movement, pressure in the oceanic HIGH off Newfoundland had risen to 30.50 inches, thus creating a pressure difference between St. Johns and Boston of 1.4 inches. In other words, an exceptionally strong pressure gradient for southeast to east surface winds over New England and the Hudson River Valley was formed. According to the well-known law of the turning of the wind with altitude southeast surface winds would turn to south winds, say from 1,500 to 3,000 meters; above that level they would have a large westerly component. These winds from off the sea were high in moisture content and heavy rains naturally resulted. Their long continuance was due to the fact that the relative position of the two barometric formations just described did not change materially for at least 36 hours.

The distribution of the precipitation for the period November 2–4 is graphically shown in Figure 2.

After the heavy rains of the day and night of November 3, a great flood was inevitable. So heavy was the rain, in fact, that the floods attained destructive proportions hours before the rains had ceased, and, most unfortunately, over much of the area covered they occurred during the night.

The great floods occurred in the Hudson Valley of New York, virtually all of Vermont and New Hampshire,

Massachusetts, and western Connecticut. There were also lesser floods in western Maine, eastern Connecticut, and Rhode Island. The flood was most severe in the Winooski Valley of Vermont, where the loss of life and property was so vast as to mark the disaster as the greatest in the history of the valley. Only of slightly less importance were the floods in the Connecticut Valley, the Lake Champlain drainage, and in the smaller streams in Massachusetts and Connecticut. One very remarkable feature was the rapidity of the rises in the rivers. There was no time for preparation except in the lower Connecticut Valley, and in many places no time for escape. Tragedy followed upon tragedy in such rapid succession that the people were left stunned and helpless for a time, and the losses of life and property were staggering for such a comparatively small area.

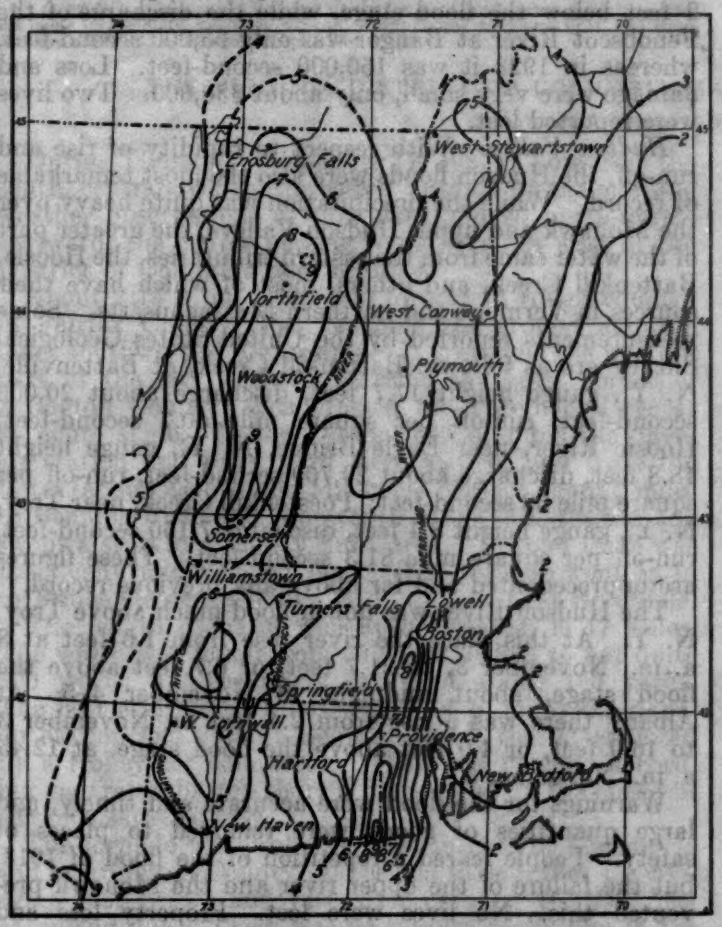



FIG. 2.—Distribution of rainfall Nov. 2–4, 1927, after a chart prepared for Mr. F. X. Goodnough, C. E., by Mr. George V. White. Copy received through the courtesy of Prof. Charles F. Brooks, Clark University.—*Editor*

Following are brief histories of the floods in the various districts. In the main they were extracted from reports made by Messrs F. E. Hartwell, Harry E. Adams, George W. Mindling, and G. S. Lindgren, meteorologists in charge of the Weather Bureau offices at Burlington, Vt., Hartford, Conn., Portland, Me., and Albany, N. Y., respectively:

*Lake Champlain district—Winooski Valley.*—The drainage basin of the Winooski River and its tributaries comprises about 1,000 square miles, and the length of the river proper is about 60 miles. About 90 per cent of the drainage basin is within the hills, mountains, and valleys where 8 or more inches of rain fell on November 3–4, and the discharge at the mouth of the river was possibly as much as 100,000 second-feet.[1]

[1] Engineering News Record, Nov. 10, 1927.

October precipitation was about 50 per cent in excess, so that when the November rains began the ground was well saturated and the brooks running full. The rainfall from November 2 to 4 broke all records for continuous rain in the State of Vermont, and all 24-hour records were also broken. At Burlington, Vt., the total rainfall for the period was 5.62 inches, with 4.49 inches in 24 hours. At Northfield, Vt., the total was 8.63 inches, with a 24-hour fall of 7.61 inches.

Records of river heights are scarce and there are very few comparative values. Montpelier, Vt., reported a high-water mark of about 16.5 feet against a previous mark of about 13.5 feet. As the surface of the main business street of the city is but 6 or 8 feet above the normal river level, there must have been from 8 to 10 feet of water over the entire business district. The known dead from the flood in the Winooski Valley numbered 48. Loss and damage reports are more or less incomplete, but it has been estimated that about one-half the losses in the State of Vermont occurred in the Winooski Valley. This would make the total for the valley about $12,000,000.

While river and flood service is not maintained in the Winooski Valley, a general flood warning sent out from Northfield was given as much distribution as possible, but the flood came so rapidly that little or nothing could be accomplished in the way of protection.

Another general warning of heavy rain on November 17 was followed by a second sharp rise, which carried out one or two temporary bridges and did other minor damage. Cold and snow checked the rising waters. Still another rise on December 1, following the heavy rain of November 30, flooded streets and many basements in Montpelier and carried away the United States Army pontoon bridge over the Winooski River at Burlington.

Space will not permit detailed description of the floods in different towns and cities, such as Burlington, Montpelier, Barre, Bolton, and Waterbury. The history of one would be the history of all.

*Other Lake Champlain drainage.*—Conditions were much the same over other drainages in the Lake Champlain district, differences lying mainly in diversity of details. Great damage was done in the valleys of the Missisquoi and Lamoille Rivers and Otter Creek, expecially the latter, in which is located the city of Rutland. There were 12 deaths reported, of which 4 occurred in Rutland, and the loss and damage were estimated at about $3,750,000.

*Connecticut Valley.*—The groundwork for these floods was laid in October. During this month there were rains of more than 1 inch over much of the valley and moderately heavy rains during the latter part of the month. These rains saturated the soil and made the streams very responsive to additional rains.

The average rainfall over the Connecticut Valley for the storm period of November 3–4 was 4.43 inches (9 stations), with maxima of 6.41 and 6.39 inches, respectively, at White River Junction and St. Johnsbury, Vt. Unofficial reports from other points in New Hampshire and Vermont indicated even heavier rains, as much as 15 inches in mountain sections. The central portion of the valley suffered most, especially the tributary sections, as the small streams were wholly unable to carry the flood waters, which rose to unprecedented heights.

At White River Junction, Vt., the Connecticut River rose from 6.4 feet at 8 a. m., November 3, to 35 feet 24 hours later. The stage of 35 feet is 5 feet higher than the former record of March 27, 1913. At Bellows Falls, Vt., there was a rise of 17.5 feet in 24 hours to an estimated

stage of 25.6 feet from 5 to 7 p. m., November 4, 6.6 feet above the previous record of March 28, 1913. At Holyoke, Mass., the crest of 14.8 feet at 6.30 p. m., November 5, was 2.1 feet above the previous record of October 5, 1869, while at Hartford, Conn., the crest of 29 feet at 11 p. m., November 6, was 0.8 foot below the previous record of May 1, 1854.

Sixteen lives were reported lost at various points throughout the main and tributary valleys. It would be useless to attempt to particularize as to the character of the loss and damage resulting from the flood. They were of the usual type of flood damage, but they were compressed within such comparatively narrow limits that they assumed tremendous proportions. While the losses in the valley were largely industrial, hundreds of families were rendered temporarily homeless. Many persons were trapped by the rapid rise of the waters, and the loss of life under the circumstances was indeed small. Accurate statistics of the loss and damage in the Connecticut Valley are not now available, but reasonable estimates place the total at about $18,000,000—$1,000,000 in Connecticut, $2,000,000 in Massachusetts, $6,000,000 in New Hampshire, and $9,000,000 in Vermont. Of these, probably all but about $2,000,000 were industrial losses.

The first warnings for the Connecticut River were issued at 9 a. m., November 4, when the first reports of the conditions in the upper valley were received. These warnings were of especial value in that portion of the valley from Northampton, Mass., southward, and the reported savings through them was $750,000. This amount would have been greatly exceeded had the warnings been more generally heeded. As it was, many persons could not be persuaded that the flood would reach the stages forecast, and they suffered accordingly.

Another heavy rain on November 17–18 called for advisory warnings of a second rapid rise, although flood stages were not actually reached as the rise was checked by low temperatures and snow.

Similar conditions in greater or less degree were experienced along all other rivers in southern New England, especially the West Branch, a western tributary of the Connecticut River. At Becket, Mass., on this river, Wheeler Dam gave way, submerging the town. Couriers in automobiles gave warning of the approach of the flood waters, and only one life was lost in Becket. The city of Westfield, Mass., also suffered severely, and four lives were lost. The Deerfield Valley of Massachusetts was probably saved from severe catastrophe by the storage behind the dams of the New England Power Co.

*Merrimac Valley.*—While the rainfall averaged more than 5 inches, flood conditions were not so severe in the Merrimac Valley, although in some localities considerable damage was done. There was no loss of human life reported. The Pemigewasset River, at Plymouth, N. H., reached a stage of 28 feet, while the Merrimac reached 14.7 feet at New Hampshire Power Co., Franklin Junction, N. H. (5.3 feet below the flood stage) on November 5; 12.2 feet at Concord, N. H. (2.2 feet above the flood stage) on November 5; and 11.2 feet at Manchester, N. H. (3.2 feet above the flood stage) on November 5. It was possible to issue some warning for the Merrimac flood early in the morning of November 4.

*Androscoggin River.*—While the precipitation was somewhat less than to the westward, it was sufficient to cause a severe flood in the Androscoggin River. In the Rangeley Lake district it was the highest known flood, and between Gorham, N. H., and the Maine boundary it was from 3 to 4 feet above any previous record. At Rumford, Me., the crest was 0.3 foot lower than in 1895. Lowlands along the river and its tributaries were extensively flooded from Gorham, N. H., to near Lewiston, Me. There was very little overflow below Lewiston.

One life was lost in New Hampshire. Reported loss and damage, excluding railroad data, were between $350,000 and $400,000, of which about $300,000 occurred in New Hampshire, mostly at Berlin and Gorham, N. H., and vicinity. Railway traffic was suspended for from one to three weeks, and highway traffic through Pinkham Notch, White Mountains, will probably be suspended until the spring of 1928.

Outside the Androscoggin system, overflow in the State of Maine was comparatively small. The stages of water were not unusual except for the time of the year. The Kennebec River at Waterville reached 9.1 feet, nearly 2 feet below the flood stage, while the discharge of the Penobscot River at Bangor was only 65,000 second-feet, whereas in 1923 it was 150,000 second-feet. Loss and damage were very small, only about $30,000. Two lives were reported lost.

*Hudson Valley.*—With respect to rapidity of rise and run-off, the Hudson floods were also the most remarkable of record. While the precipitation was quite heavy over the Mohawk and upper Hudson Valleys, the greater part of the water came from the eastern tributaries, the Hoosic, Battenkill Creek, and others, most of which have their sources in Vermont and northern Massachusetts. Some measurements reported by the United States Geological Survey are as follows: Battenkill Creek, at Battenville, N. Y., gauge height 17.7 feet, discharge about 20,000 second-feet, run-off per square mile 50.7 second-feet; Hoosic River, near Eagle Bridge, N. Y., gauge height 18.8 feet, discharge about 29,700 second-feet, run-off per square mile 58 second-feet; Poestenkill Creek, near Troy, N. Y., gauge height 8.4 feet, discharge 7,150 second-feet, run-off per square mile 81.3 second-feet. These figures are unprecedented and far above any previous record.

The Hudson River was not in flood much above Troy, N. Y. At this place the river rose from 1.6 feet at 8 a. m., November 3, to 21.7 feet, or 6.7 feet above the flood stage, about midnight of November 4–5. At Albany there was a rise from 2.4 feet on November 3 to 16.9 feet, or 4.9 feet above the flood stage, at 12.45 a. m., November 5.

Warnings for the flood were accurate and timely, and large quantities of goods were removed to places of safety. People feared a repetition of the flood of 1913, but the failure of the upper river and the Mohawk prevented this. No lives were lost. Property loss and damage, as reported, amounted to $2,027,700, most of which occurred in Columbia and Washington Counties.

### LOSS AND DAMAGE

According to the best information obtainable, there were 88 human lives lost during the floods. Grouped according to States they were as follows:

| | | | |
|---|---|---|---|
| Maine | 2 | Massachusetts | 12 |
| New Hampshire | 2 | Rhode Island | 1 |
| Vermont | 63 | Connecticut | 8 |

Of the total of 63 deaths in Vermont, 48 were in the Winooski Valley, Waterbury alone contributing 21.

Considering the comparatively small areas involved, the property losses were staggering. Inability to properly estimate the intangible and potential losses militates against accurate statements, but from reports gathered from all available sources, it appears that the total of

loss and damage was about $32,600,000. Grouped by States the losses were approximately as follows:

| | |
|---|---|
| Maine | $100,000 |
| New Hampshire | 6,400,000 |
| Vermont | [1]16,500,000 |
| Massachusetts | 6,000,000 |
| Connecticut | 1,000,000 |
| New York | 2,027,700 |
| Total | 32,027,700 |

No figures were obtained regarding the State of Rhode Island, but the amount must have been relatively small.

In the State of Vermont alone 930 bridges were either destroyed or severely damaged, and the total losses in roads and bridges, as reported by the State highway department, was $7,475,208. Industrial and agricultural losses were about $7,000,000 and $1,500,000, respectively. Houses totally destroyed numbered 264, and 1,339 more were badly damaged. Nine thousand two hundred and five persons were compelled to leave their homes. Fifteen hundred cows and some other livestock were lost. Statistics regarding other New England States were in less detail, but of the same character. The number of people rendered temporarily homeless was reported by the American Red Cross as 16,272.

Apparently railroad losses have not been included in the above summaries. These were very heavy, especially those of the Central Vermont Railway between Burlington and White River Junction, Vt. No attempt was made to secure detailed statements, but rough estimates gathered from the press and other sources aggregated about $5,000,000, irrespective of losses through enforced suspension of business, making a grand total of loss and damage of $37,577,700.

[1] A report to the Governor of Vermont by the Vermont flood survey committee gives the losses in the State, including railroad, telegraph and telephone lines, and street railways as $24,743,755, as reported up to Dec. 5, 1927.

## THE VIRGINIA–DISTRICT OF COLUMBIA–MARYLAND TORNADO OF NOVEMBER 17, 1927

[Abstract of report by WILLIS E. HURD]

During Thursday, November 17, 1927, a LOW from the south, central over southwestern Virginia by the morning weather observations of that date, moved north-northeastward, the center passing some 50 miles west of the District of Columbia near midday.

About 2:15 p. m. a tornado formed in rough country in Fairfax County, Va., reaching the ground about 3 miles southwest of Alexandria. It traversed the western part of the city and the extreme southeast corner of Arlington County, then crossed the Potomac River at an acute angle. In the District of Columbia the naval air station and navy yard were visited, and from the latter (about Eighth and M Streets SE.) for about 2 miles to Benning Road and Nineteenth Street NE. the tornado swept a strip in a thickly built area. Beyond there was practically undeveloped land. The tornado went on in to Prince Georges County, Md., to near East Riverdale.

The length of path, well authenticated, is 17 miles. The width was found from 20 yards or less to not quite 300 yards, but seemingly averaged about 140 yards. The best established times were 2:34 p. m. at the naval air station and 2:38 at Benning Road, the latter noted by a trolley-car conductor. These are in good accord, but separated by too short a distance to fix the speed of advance satisfactorily.

The tornado was probably most intense in Alexandria and in Arlington County. It seemed to be rather intense, again just before and just after crossing the District-Maryland line. There was no fatality really due to the tornado, but those injured enough to require more than first-aid treatment numbered 31—10 in Alexandria, 2 in Arlington County, and 19 in Washington.

The total damage to property, according to conservative estimates, amounted to $690,000, distributed as follows: Alexandria, $200,000; Arlington County, $125,000; naval air station, $100,000; navy yard, $80,000; remainder of District of Columbia, $120,000; near-by communities in Maryland, $65,000. In Fairfax County the damage was so slight as not to be considered.

The advance of the tornado, when the path is accurately plotted on a large-scale United States Geological Survey map, is found to have been in direction north 33° east. The primary LOW during this 12-hour period between observations advanced about north 38° east, according to the Washington weather map. On April 5, 1923, the tornado that occurred a few miles northwest of the recent track advanced about north 59° east, while the primary LOW is indicated by the REVIEW Chart II as advancing during the 12 hours north 49° east.

This is the third tornado noted in the District of Columbia within a five-year period and very much the most serious. Also it is noteworthy that the Virginia portion of the track shows far greater damage than any one tornado ever before caused in that State.

It is of interest that the observatory of the naval air station obtained an actual meteorological record of the tornado at close quarters, since it was struck by the right-hand edge of the funnel just prior to the destruction done to hangar, planes, and buildings. In advance of the tornado the reading of the barometer was 29.57 inches, which is only a hundredth of an inch lower than the simultaneous reading at the central office of the Weather Bureau, almost 4 miles to northwestward. The first violent blast at 2:34 p. m. gave a velocity of 93 miles from the south and south-southeast on the observatory register, with pressure suddenly dropping to 29.11 inches. The wind then shifted rapidly to southeast, east-southeast, and east, by which time the wind speed had dropped to 33 miles, with recovering pressure. At the Weather Bureau (distant about 3 miles) the wind at the time was from the southwest, velocity 16 miles, both wind and pressure being unaffected as far as the records indicate

## WATERSPOUT IN THE POTOMAC RIVER, WASHINGTON, D, C., NOVEMBER 17, 1927

By WILLIS E. HURD

Nearly an hour and a half after the tornado of November 17, 1927, struck the eastern shore of the Potomac or, precisely, at 3:54 p. m., at which time the worst rain and wind squall of the general cyclone occurred at Washington, D. C., a waterspout formed in the river west of Anacostia. Although the spout was considerably veiled by the gloom and heavy rain then prevailing, it was seen from the naval air station to move directly toward the southeast and dash itself in pieces on the shore two minutes later. It is said to have been some 300 feet in height, reaching to the squall cloud, with river water seen to course up about one-third of its length. At this time the maximum wind velocity of 60 miles an hour for a two-minute period from the southwest was registered at the Weather Bureau. The wind direction for the hour preceding 3:45 p. m. had been from the south. This is probably the first waterspout known to have occurred along this portion of the Potomac.

## NOTES AND ABSTRACTS

### DAMAGING GAS EXPLOSION AT PITTSBURGH, PA.

By W. S. BROTZMAN

[Weather Bureau office, Pittsburgh, Pa.]

On Monday, November 14, 1927, at 8:43 a. m., an explosion of natural gas occurred in Pittsburgh which produced tremors throughout the city such as might have been caused by a severe earthquake. The explosion caused the death of 28 persons, the injury of more than 400, and a property loss of about $5,000,000.

The scene of the explosion was about 1 mile west of the Weather Bureau office. The loud report and the jolt experienced at that office turned attention in the direction of its source. The first view showed what seemed to be a dense mass of dust and smoke rising from the ruins. An instant later the mass burst into flames and a ball of fire apparently 100 feet in diameter separated from the dense mass and began to rise. It rose rapidly, the volume growing smaller with ascent until finally it burned out at an estimated height of 1,000 feet.

In the immediate vicinity of the explosion buildings were leveled with but few exceptions. Within a radius of half a mile most of the buildings were badly damaged and many persons were injured. Extending the radius to 1 mile there was damage to plate-glass windows in Pittsburgh amounting to $50,000, and damage such as broken windows, the falling of plaster, etc., was noted as far as 6 miles in all directions.

The sound of the explosion was heard throughout a radius of 15 to 20 miles.

The barograph in the Weather Bureau office rose about 0.035 inch at the time of explosion and immediately dropped back to the original pressure. A microbarograph in the Taylor Instrument Co.'s office, three floors below the Weather Bureau office, recorded an increase of 0.050 inch and immediately thereafter showed a reaction of 0.015 inch below the original pressure at the time of the explosion.

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### ATTEMPTS TO DISPEL FOG

By C. FITZHUGH TALMAN

[Reprinted from "Why the Weather?", Science Service (Inc.), Washington]

The problem of dispelling fog by artificial means is perennial. Years ago we heard that Sir Oliver Lodge had solved it by the use of an electrical contrivance erected on his house in Liverpool—but the city on the Mersey is still afflicted with fogs. Then the London County Council was approached with a scheme for clearing away the celebrated "London particular" by the use of explosives. The promoter of this scheme proposed to utilize a quantity of mortars which had been designed for the purpose of dispelling hailstorms in Italy but had failed to produce the desired effects. The county authorities refused to provide funds for this experiment and the project was abandoned.

Just before the World War the city of Lyons voted money for experiments in preventing the formation of fog in that city by coating the rivers Rhone and Saone with oil. About the same period the Cottrell process of electrical precipitation, which is so successfully applied in treating industrial dusts and fumes, was tried on the fogs of the California coast, but nothing seems to have resulted. Quite recently the naval aircraft factory at Philadelphia has been the scene of experiments in dissipating fog by means of electrified sprays. No tangible results have been announced.

Schemes for draining off the fog-laden air from flying fields and also for warming the air over such places and thus causing the fog to evaporate have been investigated and pronounced impracticable.

On a small scale and in favorable circumstances fog can be dispelled, but all known methods are too costly for ordinary commercial use. Thus the matter now stands.

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### METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, OCTOBER, 1927

By J. BUSTOS NAVARRETE

[Observatorio del Salto, Santiago, Chile]

The many atmospheric depressions of considerable importance charted off central Chile caused much cloudiness, frequent fog, and early morning mists and light rains, especially along the coast. Precipitation was generally scant or deficient; at Santiago, in the middle of the central region, the total for the month was only 7.6 millimeters (0.30 inch), and at Valdivia, in the middle of the southern region, it was 85.3 millimeters (3.30 inches).

The principal depressions appeared on the 1st–2d, 6th–9th, 11th–14th, 20th, 23d–24th, and 26th, and the principal anticyclones on the 2d–6th, 10th–18th, 21st–25th, and 27th–31st.

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### METEOROLOGICAL SUMMARY FOR BRAZIL, OCTOBER, 1927

By J. DE SAMPAIO FERRAZ, Director

(Directoria de Meteorologia, Rio de Janeiro)

Southern and central regions of the country were subject to remarkably active general circulation. As many as eight anticyclones crossed the continent, mostly in the normal tracks for the season. These high-pressure areas moved swiftly and were followed by depressions with more definite action than usual. Consequently general weather conditions in the regions referred to were particularly changeful, with several moderate gales. In the first and last decades low-pressure areas were exceptionally active, with the formation of secondaries and high winds. A destructive whirlwind swept over Ponta Grossa, in Parana, with tornado effects, which fact is of very rare occurrence in Brazil.

Rainfall was very scarce in the north and center, but generally plentiful in the south, principally in the higher latitudes.

Cane, cotton, and cocoa harvesting generally satisfactory, except cocoa in Bahia, where it is smaller than expected. Coffee in Sao Paulo in excellent condition with intense flowering. Wheat in the south also very promising. Other small grain and vegetables generally in good condition.

Weather in Rio de Janeiro was very unsettled, temperature was also very variable. On the 16th the thermometer rose to 36.8° centigrade (98.2° F.) with unexpected heat. The city was visited by five moderate gales. Pressure and temperature on the average were, however, normal.

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**Gruner, P., & Kleinert, H.**
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Per la gara della coppa Schneider. Cenni sommari suile condizioni meteorologiche normali de Venezia durante l mesi de agosto, settembre e ottobre. Roma. 1927. 14 p. figs. 23 cm.

**La Ville, H. C.**
St. Louis tornado. p. 680–688. illus. 24½ cm. (Stone & Webster journ., v. 41, no. 5, Nov., 1927.)

**Marshall, Robert.**
Influence of precipitation cycles on forestry. p. 415–429. figs. 24½ cm. [Journ. of forestry, v. 25, no. 4, Apr., 1927.]

**Pavia. R. Osservatorio geofisico.**
Sondaggi con palloni sonda effettuati a Pavia (Italia.) n. p. 1926. unp. 30 cm. [Typewritten.]

**Petersen, Helge.**
On the heating of the uppermost atmosphere caused by cathodic rays from the sun. København. 1927. 9 p. 25½ cm. (Pub. Danske met. inst. Comm. magnét.)

**Petterson, E. G.**
Studier över de olika molnformernas förekomst i Helsingfors. Helsingfors. 1923. 39 p. 24 cm. (Soc. sci. fenn. Comm. physico-math. I. 34.)

**Rudaux, Lucien.**
Green ray "mystery" explained: remarkable sunset phases. p. 712–713. illus. 37½ cm. (Ill. London news, Oct. 22, 1927. v. 81.)

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Leitfaden der Meteorologie, nach Hann-Sürings Lehrbuch der Meteorologie. Leipzig. 1927. xii, 426 p. plates (part fold.) 26½ cm.

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Velocità delle correnti di marea nel canale porto di Lido. Venezia. 1927. [3 p.] charts. 28½ cm.

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The following titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

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Gerasimovič, B. P. Astrophysical aspects of the general field of penetrating radiation.

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Hartmann, Wilhelm. Blau-ultraviolette Sonnenstrahlung und atmosphärische Vorgänge. p. 30–72.
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Lindholm, F. Über die Staubtrübung der Atmosphäre 1909 bis 1926. p. 127–144.

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Wreckage in its wake. The St. Louis tornado rips a path of ruin across the city. p. 1–6.

*France. Académie des sciences. Comptes rendus. Paris. t. 184. 7 novembre, 1927.*
Huber, Georges-Henri. Influence des surfaces de discontinuité atmosphériques sur la propagation des ondes courtes. p. 934–936.

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Simon, A. W. The electrostatics of the thunderstorm. p. 617–647.

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Khambata, Sam J. Radio-active products present in the atmosphere of Bombay. p. 25–27.

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Holtzmann, M. A. Some applications of a rotating anemometer. p. 215. [Abstract.]
Kalgorodov, A. I. The seasons in connection with analytical and comparative methods of their study. p. 188. [Abstract.]
Loveyko, V. Communiqué préliminaire sur la question des conditions synoptiques occasionnant les "Zajores" sur les fleuves: Néva, Svir, Cheksna et Volkhov. p. 172. [Abstract.]
Myrbach, Otto. Die Schwankungen der Grosswetterlage in ihrer Abhängigkeit von der Sonnentätigheit nebst einen Anhang über die Alteration dieser Beziehungen durch die Mondphase. p. 217–231.
Tchurkina, W. N. Über einige Eigentümlichkeiten des Regimes der Lufttemperatur während der Dürren im Osten und Südosten des europäischen Teils d. USSR. p. 162–163. [Abstract.]
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Wiese, W. J. Beiträge zur Vorhersage der mittleren monatlichen und jahreszeitlichen Werte meteorologischer Elemente. III. Die mittlere Temperatur der Luft im Januar in Leningrad. p. 143–144. [Abstract.]

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Maurer, J. Les catastrophes météorologiques et l'activité solaire. p. 178–180.

*Meteorological magazine. London. v. 62. November, 1927.*
Britton, C. E. A Somersetshire weather diary. p. 238–240.
Brooks, C. E. P. Monthly distribution of storms. p. 229–232.
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Lamb, C. W. Minimum temperatures as recorded in the Stevenson screen and in an adjacent transport shed with an open end. p. 232–234.
Note on the lasting qualities of small rubber balloons. p. 237–238.
Zealley, P. R. The play of the winds. p. 228–229.

*Meteorologische Zeitschrift. Braunschweig. Band 44. Oktober, 1927.*
Aufsess, Kochel v. Beziehungen zwischen Sonnentätigkeit und Luftdruckverteilung über Europa im zweiten Vierteljahr 1927. p. 380–385.
Dorno, C. Parallelmessungen der photochemischen Ortshelligkeit nördlichem Polarkreis und südlichem Wendekreis mittels Eders Graukeilphotometer. p. 369–380.
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Götz, F. W. Paul. Erwiderung zu C. Dorno, Über Ozonmessungen auf spektroskopischem Wege. p. 389–390.
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Škreb, S. Das aschfarbige Mondlicht. p. 393.
Škreb, S. Definition eines Regenfalls. p. 391–393.

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*Royal meteorological society. Memoirs. London. v. 2. no. 11.*
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*School science and mathematics. Chicago. v. 27. December, 1927.*
Edwards, Hiram W. A discussion of some of the principles underlying rainfall. p. 926–928.

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Stäger, A. Atmospheric disperse systems. p. 786–787. [Abstract from Kolloid Zeits.]

*Science and invention. New York. v. 15. January, 1928.*
Gernsback, Hugo. Weather control. p. 783.

*Sociedad astronómica de España y América. Revista. Barcelona. Año 17. Septiembre–octubre, 1927.*
Mendirichaga, Mariano Hernández. Otros factores en climatología. p. 77–79.

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Pollak, Leo Wenzel. Über die Verwendung des Lochkartenverfahrens in der Klimatologie. p. 528–532.

## SOLAR OBSERVATIONS

### SOLAR AND SKY RADIATION MEASUREMENTS DURING NOVEMBER, 1927

By IRVING F. HAND, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1924, 52:42, January, 1925, 53:29, and July, 1925, 53:318.

Table 1 shows that solar radiation intensities were below the normal values for November at Washington, D. C., and Lincoln, Nebr., but above normal at Madison, Wis.

Table 2 shows a deficiency in the total solar radiation received on a horizontal surface directly from the sun and diffusely from the sky at all three stations for which normals have been determined as compared with the November normals for these stations.

Owing to cloudy conditions and snow on the ground, only a single polarization measurement was made at each station, Washington and Madison. The value 57 per cent obtained at Washington on the 26th is below normal for November, while the value of 73 per cent obtained on the 2d at Madison is above normal for that station.

TABLE 1.—*Solar radiation intensities during November, 1927*

[Gram-calories per minute per square centimeter of normal surface]

**Washington, D. C.**

| Date | Sun's zenith distance: 8 a.m. | 77.8° | 75.7° | 70.7° | 60.0° | 0.0° | 60.0° | 70.7° | 75.7° | 77.8° | Noon |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 75th mer. time | Air mass: A. M. | | | | | P. M. | | | | Local mean solar time |
| | e. | 5.0 | 4.0 | 3.0 | 2.0 | *1.0 | 2.0 | 3.0 | 4.0 | 5.0 | e. |
| | mm. | cal. | cal. | cal. | cal. | cal. | cal. | cal. | cal. | cal. | mm. |
| Nov. 1 | 8.48 | | | | 1.14 | | | | | | 10.59 |
| Nov. 5 | 4.37 | | | | 1.32 | | | | | | 4.17 |
| Nov. 7 | 2.36 | | | 1.16 | | | | | | | 2.74 |
| Nov. 14 | 4.17 | 0.72 | 0.85 | 0.98 | | | | | | | 6.76 |
| Nov. 19 | 2.74 | | | 1.02 | | | | | | | 2.36 |
| Nov. 25 | 5.56 | | | 0.90 | 1.09 | | | | | | 6.02 |
| Nov. 26 | 5.16 | | | 0.88 | | | | | | | 6.02 |
| Means | | (0.72) | (0.85) | 0.98 | 1.18 | | | | | | |
| Departures | | −0.63 | ±0.00 | −0.01 | ±0.00 | | | | | | |
| **Madison, Wis.** | | | | | | | | | | | |
| Nov. 2 | 3.30 | | 1.12 | 1.00 | | | 1.39 | 1.20 | | | 3.15 |
| Nov. 12 | 2.49 | 1.01 | 1.14 | 1.28 | 1.42 | 1.57 | | | | | 1.37 |
| Means | | (1.01) | (1.13) | (1.14) | (1.42) | (1.57) | (1.39) | (1.20) | | | |
| Departures | | +0.13 | +0.11 | −0.01 | +0.12 | +0.05 | +0.04 | +0.04 | | | |
| **Lincoln, Nebr.** | | | | | | | | | | | |
| Nov. 3 | 3.99 | 0.78 | 0.97 | 1.18 | | | | | | | 4.17 |
| Nov. 16 | 1.88 | | 1.00 | 1.16 | 1.36 | 1.60 | 1.31 | 1.12 | 0.97 | 0.85 | 1.96 |
| Nov. 24 | 2.87 | | 1.03 | 1.19 | | | | | | | 2.87 |
| Nov. 25 | 3.63 | | 1.03 | 1.19 | 1.27 | | | | | | 3.45 |
| Nov. 27 | 3.45 | | | | | | | 1.09 | 0.94 | | 3.99 |
| Nov. 28 | 4.37 | | | | | | | 1.19 | 1.01 | 0.81 | 3.43 |
| Nov. 30 | 2.49 | | | | | | | 1.25 | 1.03 | | 1.37 |
| Means | | (0.78) | 1.01 | 1.18 | (1.32) | (1.60) | (1.31) | 1.16 | 0.99 | (0.83) | |
| Departures | | −0.15 | −0.02 | −0.01 | −0.03 | +0.02 | −0.03 | −0.03 | −0.06 | −0.19 | |

* Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

| Week beginning— | Average daily radiation: Washington | Madison | Lincoln | Chicago | New York | Twin Falls | Average daily departure from normal: Washington | Madison | Lincoln |
|---|---|---|---|---|---|---|---|---|---|
| 1927 | cal. | cal. | cal. | cal. | cal. | cal. | cal. | cal. | cal. |
| Oct. 29 | 234 | 166 | 220 | 132 | 160 | 269 | −4 | ±0 | −24 |
| Nov. 5 | 173 | 112 | 158 | 73 | 104 | 169 | −44 | −38 | −67 |
| Nov. 12 | 190 | 110 | 160 | 76 | 143 | 131 | −5 | −15 | −36 |
| Nov. 19 | 204 | 69 | 151 | 50 | 114 | 136 | +22 | −48 | −47 |
| Nov. 26 | 148 | 128 | 204 | 56 | 61 | 104 | −7 | +13 | +14 |
| Deficiency since first of year on Dec. 2 | | | | | | | −8,722 | −4,627 | −7,268 |

## POSITIONS AND AREAS OF SUN SPOTS

Communicated by Capt. C. S. Freeman, Superintendent U. S. Naval Observatory

[Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson observatories]

| Date | Eastern standard civil time | Heliographic: Longitude | Latitude | Area[1]: Spot | Group |
|---|---|---|---|---|---|
| 1927 | h. m. | ° | ° | | |
| Nov. 1 (Naval Observatory) | 11 45 | −57.0 | +18.0 | | 139 |
| | | −45.0 | −12.0 | | 77 |
| | | −41.0 | +15.5 | | 62 |
| | | +30.0 | +17.5 | | 62 |
| | | +35.0 | +15.0 | | 46 |
| | | +38.0 | +10.5 | | 108 |
| | | +43.5 | −17.0 | | 31 |
| Nov. 2 (Naval Observatory) | 14 36 | −42.0 | +18.0 | 108 | |
| | | −29.5 | −12.0 | | 62 |
| | | −26.0 | +15.5 | 0 | |
| | | +48.0 | +17.5 | | 31 |
| | | +54.5 | +10.5 | | 62 |
| Nov. 4 (Naval Observatory) | 14 14 | −16.0 | +17.5 | | 77 |
| | | −1.5 | +17.0 | | 46 |
| | | +30.0 | +21.5 | | 15 |
| Nov. 5 (Naval Observatory) | 11 38 | −2.0 | +18.0 | | 77 |
| | | +11.5 | +17.0 | | 31 |
| | | +27.0 | +18.0 | 15 | |
| | | +43.0 | +22.0 | | 62 |
| Nov. 6 (Naval Observatory) | 11 43 | −55.5 | −10.0 | | 31 |
| | | +13.0 | +18.0 | | 46 |
| | | +25.5 | +16.0 | | 46 |
| | | +38.0 | +21.0 | | 62 |
| Nov. 7 (Naval Observatory) | 11 45 | −39.5 | −10.0 | | 31 |
| | | +24.5 | +18.5 | | 31 |
| | | +70.5 | +21.0 | | 31 |
| Nov. 9 (Naval Observatory) | 11 54 | −82.0 | −8.0 | | 278 |
| | | −71.0 | +14.5 | 62 | |
| | | −30.5 | +6.0 | | 31 |
| | | −15.0 | −11.0 | | 154 |
| | | −9.5 | −10.0 | | 278 |
| | | +32.0 | −11.5 | | 46 |
| Nov. 11 (Naval Observatory) | 11 41 | −68.0 | +6.5 | | 93 |
| | | −64.0 | +7.5 | | 108 |
| | | −59.0 | +7.0 | | 93 |
| | | −59.0 | −7.0 | | 93 |
| | | −54.0 | −7.5 | 216 | |
| | | −53.5 | −9.0 | | 77 |
| | | −27.5 | −11.5 | | 31 |
| | | −3.0 | +7.5 | | 15 |
| | | +12.0 | −10.0 | | 278 |
| | | +17.5 | −10.0 | | 617 |
| | | +58.0 | −11.5 | | 31 |

[1] Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere.

*Positions and areas of sun spots*—Continued

| Date | Eastern standard civil time | Heliographic Longitude | Heliographic Latitude | Area Spot | Area Group |
|---|---|---|---|---|---|
| | h. m. | ° | ° | | |
| Nov. 12 (Naval Observatory) | 11 51 | −57.0 | +6.5 | | 93 |
| | | −47.5 | +8.5 | | 93 |
| | | −47.5 | −6.0 | | 46 |
| | | −45.0 | +5.0 | 31 | |
| | | −40.5 | −7.5 | | 278 |
| | | −11.0 | −12.0 | 6 | |
| | | +0.5 | +8.0 | | 31 |
| | | +24.0 | −10.5 | | 278 |
| | | +31.0 | −10.0 | | 670 |
| Nov. 13 (Naval Observatory) | 11 45 | −42.5 | +6.5 | | 93 |
| | | −37.5 | +8.5 | | 46 |
| | | −31.5 | +5.0 | | 46 |
| | | −31.0 | −7.0 | | 77 |
| | | −30.0 | +9.5 | | 31 |
| | | −27.5 | −7.5 | 216 | |
| | | −24.5 | −9.0 | 31 | |
| | | +38.5 | −9.5 | | 340 |
| | | +42.0 | −8.5 | | 185 |
| | | +47.0 | −10.0 | | 370 |
| Nov. 14 (Naval Observatory) | 11 46 | −30.0 | +5.5 | 31 | |
| | | −22.5 | +8.5 | | 77 |
| | | −18.5 | +9.0 | | 46 |
| | | −17.0 | −7.5 | | 77 |
| | | −13.0 | −7.5 | 185 | |
| | | −9.5 | −9.0 | | 6 |
| | | +42.5 | −12.0 | 6 | |
| | | +53.0 | −9.5 | | 340 |
| | | +60.0 | −10.0 | | 432 |
| Nov. 15 (Naval Observatory) | 11 45 | −17.0 | +5.5 | 15 | |
| | | −9.5 | +8.5 | | 154 |
| | | −5.0 | +9.0 | | 62 |
| | | −3.5 | −7.0 | | 108 |
| | | +0.5 | −7.5 | 216 | |
| | | +55.5 | −10.0 | | 247 |
| | | +69.0 | −8.0 | 46 | |
| | | +73.0 | −10.0 | | 340 |
| Nov. 16 (Naval Observatory) | 12 11 | −77.0 | +11.5 | | 46 |
| | | −72.5 | +10.5 | | 154 |
| | | −29.0 | −20.5 | | 37 |
| | | −2.0 | +5.5 | 22 | |
| | | +4.0 | +8.5 | | 77 |
| | | +8.0 | +9.0 | | 62 |
| | | +12.5 | −7.5 | | 340 |
| | | +70.0 | +11.0 | 62 | |
| | | +80.0 | −10.5 | | 309 |
| Nov. 18 (Naval Observatory) | 12 24 | −76.0 | −13.5 | 31 | |
| | | −48.5 | +10.5 | | 62 |
| | | −43.0 | +11.0 | | 154 |
| | | −0.5 | −20.5 | 62 | |
| | | +24.5 | +5.5 | 9 | |
| | | +31.5 | +8.0 | | 46 |
| | | +36.0 | +9.0 | | 31 |
| | | +40.0 | −8.0 | | 278 |
| | | +40.5 | −10.5 | 62 | |
| | | +75.0 | −19.0 | 77 | |
| Nov. 19 (Naval Observatory) | 11 42 | −63.0 | −15.5 | | 123 |
| | | −36.0 | +11.0 | | 62 |
| | | −30.5 | +10.5 | | 231 |
| | | −12.0 | −6.5 | | 62 |
| | | +11.5 | −20.5 | 46 | |
| | | +52.5 | −8.0 | | 216 |
| Nov. 20 (Naval Observatory) | 11 43 | −51.5 | −13.5 | | 216 |
| | | −21.0 | +10.0 | | 15 |
| | | −17.5 | +10.5 | | 139 |
| | | +3.0 | −7.5 | | 15 |
| | | +24.0 | −20.5 | | 37 |
| | | +27.0 | +13.0 | | 15 |
| | | +65.0 | −8.0 | | 154 |
| Nov. 22 (Naval Observatory) | 11 36 | −25.5 | −14.0 | | 185 |
| | | +7.5 | +10.5 | | 15 |
| | | +11.0 | +10.5 | | 123 |
| | | +31.0 | −7.5 | | 108 |
| | | +50.5 | −20.0 | 40 | |
| | | +56.0 | +13.0 | 15 | |
| Nov. 23 (Naval Observatory) | 11 29 | −26.0 | −14.5 | | 123 |
| | | −23.0 | −17.5 | | 93 |
| | | −14.0 | −14.0 | | 108 |
| | | −10.5 | −15.0 | 31 | |
| | | +21.0 | +12.0 | | 62 |
| | | +23.5 | +10.5 | | 108 |
| | | +40.0 | −7.0 | 62 | |
| | | +43.5 | −7.5 | 46 | |
| | | +63.5 | −20.0 | 15 | |

*Positions and areas of sun spots*—Continued

| Date | Eastern standard civil time | Heliographic Longitude | Heliographic Latitude | Area Spot | Area Group |
|---|---|---|---|---|---|
| | h. m. | ° | ° | | |
| Nov. 24 (Naval Observatory) | 11 54 | −17.5 | +17.5 | | 15 |
| | | −13.5 | −15.0 | | 170 |
| | | −13.0 | −18.0 | | 31 |
| | | −8.0 | −17.5 | | 170 |
| | | −0.5 | −15.0 | | 46 |
| | | +3.0 | −15.0 | 31 | |
| | | +33.5 | +12.0 | | 31 |
| | | +37.5 | +10.5 | | 123 |
| | | +53.5 | −6.5 | | 77 |
| | | +57.5 | −7.0 | 9 | |
| | | +62.0 | −7.5 | 31 | |
| Nov. 26 (Naval Observatory) | 11 43 | −74.0 | +5.0 | 6 | |
| | | −52.5 | −20.0 | 9 | |
| | | −45.0 | −16.5 | 15 | |
| | | +10.0 | −18.0 | 139 | |
| | | +16.0 | −17.5 | | 340 |
| | | +27.0 | −15.0 | | 46 |
| | | +30.5 | −15.0 | 31 | |
| | | +67.0 | +11.0 | 123 | |
| | | +80.0 | −7.0 | 62 | |
| Nov. 27 (Naval Observatory) | 11 31 | −62.0 | +4.5 | 31 | |
| | | −40.0 | −20.0 | 6 | |
| | | +22.0 | −18.0 | 123 | |
| | | +26.5 | −16.5 | | 216 |
| | | +31.0 | −18.0 | | 247 |
| | | +40.5 | −15.0 | | 15 |
| | | +44.0 | −15.0 | 9 | |
| | | +79.0 | +10.5 | 93 | |
| Nov. 29 (Naval Observatory) | 12 43 | −34.5 | +5.0 | 6 | |
| | | −0.5 | −14.5 | | 62 |
| | | +48.5 | −18.0 | 108 | |
| | | +54.0 | −16.5 | | 278 |
| | | +59.5 | −17.5 | 370 | |
| Nov. 30 (Naval Observatory) | 11 21 | +12.5 | −14.5 | | 77 |
| | | +30.0 | −10.0 | 15 | |
| | | +61.0 | −18.0 | 93 | |
| | | +66.0 | −16.5 | | 247 |
| | | +72.0 | −17.5 | 463 | |

## PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR NOVEMBER, 1927[1]

[Data supplied by Prof. A. Wolfer, Zurich, Switzerland]

| November | Relative numbers | November | Relative numbers |
|---|---|---|---|
| 1 | 65 | 16 | |
| 2 | 56 | 17 | 92 |
| 3 | 32 | 18 | 84 |
| 4 | 25 | 19 | 67 |
| 5 | | 20 | |
| 6 | 36 | 21 | 82 |
| 7 | | 22 | |
| 8 | 15 | 23 | 81 |
| 9 | 49 | 24 | |
| 10 | 74 | 25 | 92 |
| 11 | | 26 | 72 |
| 12 | 106 | 27 | 69 |
| 13 | 113 | 28 | |
| 14 | 103 | 29 | |
| 15 | 91 | 30 | |

Number of observations, 20; mean, 70.2.

## AEROLOGICAL OBSERVATIONS

By W. R. STEVENS

Free-air temperature departures for November were mostly positive except at Ellendale, where subnormal temperatures prevailed at all levels observed.

Relative humidity departures were small but mostly positive; vapor pressures were above normal at all stations except Ellendale.

Resultant wind directions were near normal, but there was a tendency toward greater resultant velocities than usual. The latter averaged twice as great as in the preceding month, yet exceptionally strong winds aloft were but infrequently observed, only one station reporting a velocity as high as 40 meters per second. Below 2,000 meters the winds were largely of southerly component except in the northern Plains States where they were northerly at all altitudes. Above 2,000 meters the winds were mostly W. to WNW. Easterly components prevailed over Jacksonville to 750 meters, New Orleans to 750 meters, San Juan to 2,500 meters, and Key West to 4,000 meters.

The kite flight made at Due West on the 3d is of special interest since it was obtained within a rather well-developed low pressure area, Greenville, S. C., 29.60 inches. The ascent shows a WSW. wind at practically all levels from the surface to 4,553 meters and a shift to W. on the descent. The lapse rate increased from less than adiabatic for moist air to slightly superadiabatic. The temperature record for the ascent shows no inversions while the descent shows three. The origin of these inversions seems to be due to advection of slightly colder air at various levels which leaves an inversion above.

The flight of the 15th at Groesbeck was made during the passage of a cold front. During the ascent the wind was from a southerly direction at nearly all levels. Before the kites were landed the wind at lower levels had shifted to northerly with a sharp decrease in temperature from the surface to 500 meters, and a smaller decrease to 2,000 meters. The latter was due to lifting of the air by the underrunning cold wedge which resulted in adiabatic cooling and saturation. We find the characteristic inversion present above the surface layer of coldair. Light rain began shortly after the arrival of the cold front.

The kite ascent of the 27th at Royal Center was made in a trough which extended from southern Quebec to Oklahoma and was followed by a heavy rain that afternoon and night. The overrunning of a warm southerly wind by a WNW. wind producing an adiabatic to superadiabatic lapse rate for moist air, as shown by this flight, is quite typical of trough conditions in this country. The free-air conditions on this date are shown in the following table:

| Time | Altitude | Temperature | ΔT/100 | Relative humidity | Wind | |
|---|---|---|---|---|---|---|
| | | | | | Direction | Velocity |
| | *Meters* | *°C.* | | *Per cent* | | *m. p. s.* |
| 7:56 a. m. | 225 | 16.0 | | 81 | SW. | 5.8 |
| 8:03 a. m. | 571 | 12.9 | 0.90 | 89 | WSW. | 18.4 |
| 8:28 a. m. | 1,723 | 5.0 | 0.61 | 100 | W. | 21.6 |
| 8:30 a. m. | 1,873 | 7.6 | −1.73 | 43 | W. | 20.8 |
| 8:54 a. m. | 2,919 | −1.0 | 0.82 | 100 | WNW. | 22.2 |
| 9:12 a. m. | 3,502 | −4.4 | 0.58 | 99 | WNW. | 22.7 |

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during November, 1927*

TEMPERATURE (°C.)

| Altitude, m. s. l. (meters) | Broken Arrow, Okla. (233 meters) | | Due West, S. C. (217 meters) | | Ellendale, N. Dak. (444 meters) | | Groesbeck, Tex. (141 meters) | | Royal Center, Ind. (225 meters) | | Washington, D. C.* (7 meters) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Departure from 10-year mean | Mean | Departure from 7-year mean | Mean | Departure from 10-year mean | Mean | Departure from 10-year mean | Mean | Departure from 10-year mean | Mean | Departure from 3-year mean |
| Surface | 11.2 | +1.5 | 12.1 | +1.2 | −4.8 | −2.3 | 18.6 | +5.2 | 0.7 | +2.1 | 12.7 | +5.4 |
| 250 | 11.1 | +1.3 | 11.8 | +1.1 | | | 18.0 | +4.8 | 6.5 | +2.1 | 11.7 | +5.2 |
| 500 | 9.9 | +1.2 | 11.3 | +1.5 | −4.8 | −2.3 | 17.0 | +4.4 | 4.9 | +1.9 | 11.5 | +5.1 |
| 750 | 9.6 | +1.6 | 10.7 | +1.8 | −5.0 | −2.6 | 15.9 | +4.0 | 3.8 | +1.7 | 11.5 | +5.5 |
| 1,000 | 9.6 | +2.1 | 9.7 | +1.7 | −4.7 | −2.5 | 15.0 | +3.7 | 3.3 | +1.8 | 10.8 | +5.8 |
| 1,250 | 9.6 | +2.6 | 8.6 | +1.3 | −4.8 | −2.6 | 13.8 | +3.3 | 2.1 | +1.2 | 9.7 | +5.9 |
| 1,500 | 9.3 | +2.9 | 7.3 | +0.9 | −5.3 | −2.9 | 12.6 | +2.9 | 1.2 | +0.9 | 8.8 | +5.5 |
| 2,000 | 7.3 | +2.7 | 4.7 | +0.1 | −7.6 | −3.7 | 10.4 | +2.7 | −1.0 | +0.3 | 7.1 | +4.4 |
| 2,500 | 4.9 | +2.5 | 2.7 | −0.1 | −10.1 | −4.0 | 8.0 | +2.3 | −3.4 | 0. | 4.4 | +4.0 |
| 3,000 | 1.9 | +1.9 | 0.7 | +0.1 | −13.1 | −4.4 | 5.7 | +2.4 | −5.8 | −0.1 | 1.7 | +3.7 |
| 3,500 | 0.3 | +2.8 | −1.9 | +0.2 | −15.8 | −4.3 | 3.2 | +2.7 | −7.4 | +0.3 | −1.0 | +3.6 |
| 4,000 | | | −3.7 | +1.0 | −18.3 | −3.9 | −1.3 | +1.0 | −9.3 | +1.1 | −3.8 | +3.8 |
| 4,500 | | | −0.1 | +2.0 | −22.1 | −4.7 | | | −12.3 | +0.8 | −4.8 | +3.8 |
| 5,000 | | | | | | | | | | | −8.6 | +3.8 |

RELATIVE HUMIDITY (%)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surface | 72 | +5 | 75 | +5 | 74 | −4 | 77 | +3 | 76 | +3 | 68 | −8 |
| 250 | 72 | +5 | 74 | +5 | | | 78 | +6 | 76 | +3 | 69 | −5 |
| 500 | 72 | +9 | 71 | +6 | 73 | −4 | 80 | +13 | 77 | +5 | 67 | −2 |
| 750 | 70 | +9 | 70 | +7 | 69 | −3 | 81 | +18 | 78 | +8 | 64 | −2 |
| 1,000 | 65 | +7 | 69 | +7 | 63 | −4 | 76 | +17 | 76 | +9 | 64 | −2 |
| 1,250 | 61 | +7 | 68 | +8 | 60 | −3 | 72 | +16 | 73 | +10 | 66 | −1 |
| 1,500 | 57 | +6 | 66 | +9 | 61 | +1 | 65 | +12 | 69 | +10 | 64 | −1 |
| 2,000 | 48 | +2 | 65 | +14 | 67 | +10 | 52 | +5 | 58 | +4 | 56 | +1 |
| 2,500 | 40 | −2 | 53 | +10 | 60 | +9 | 44 | +3 | 50 | 0 | 54 | +3 |
| 3,000 | 42 | 0 | 44 | +4 | 67 | +10 | 31 | −6 | 60 | +10 | 46 | +1 |
| 3,500 | 43 | +3 | 35 | −3 | 58 | 0 | 21 | −15 | 58 | +10 | 42 | +1 |
| 4,000 | | | 1 | −30 | 55 | −5 | 45 | +11 | 49 | +4 | 32 | −5 |
| 4,500 | | | 13 | −24 | 80 | +17 | | | 40 | +4 | 22 | −5 |
| 5,000 | | | | | | | | | | | 14 | −5 |

VAPOR PRESSURE (mb.)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surface | 10.39 | +2.21 | 11.00 | +1.54 | 3.22 | −0.99 | 16.85 | +4.74 | 8.32 | +1.77 | 10.41 | +2.20 |
| 250 | 10.33 | +2.21 | 10.90 | +1.60 | | | 16.52 | +4.89 | 8.25 | +1.77 | 10.02 | +2.37 |
| 500 | 9.57 | +2.20 | 10.38 | +2.02 | 3.15 | −0.98 | 16.05 | +5.48 | 7.62 | +1.80 | 9.64 | +2.41 |
| 750 | 9.24 | +2.47 | 9.82 | +2.13 | 2.89 | −0.94 | 15.06 | +5.53 | 7.22 | +1.90 | 9.12 | +2.44 |
| 1,000 | 8.51 | +2.30 | 9.06 | +1.97 | 2.65 | −0.90 | 13.40 | +4.84 | 6.92 | +2.11 | 8.69 | +2.53 |
| 1,250 | 7.94 | +2.29 | 8.08 | +1.75 | 2.51 | −0.80 | 11.63 | +4.06 | 6.17 | +1.90 | 8.38 | +2.62 |
| 1,500 | 6.89 | +1.86 | 7.08 | +1.51 | 2.42 | −0.67 | 9.74 | +3.10 | 5.42 | +1.68 | 7.79 | +2.43 |
| 2,000 | 4.59 | +0.69 | 5.44 | +1.26 | 2.26 | −0.37 | 6.55 | +1.94 | 3.78 | +0.79 | 6.02 | +1.86 |
| 2,500 | 2.99 | −0.02 | 3.35 | +0.42 | 1.86 | −0.37 | 4.55 | +0.74 | 2.33 | +0.48 | 4.71 | +1.55 |
| 3,000 | 2.46 | +0.01 | 1.95 | −0.23 | 1.49 | −0.34 | 2.61 | −0.13 | 2.79 | +0.72 | 3.39 | +1.27 |
| 3,500 | 1.90 | +0.05 | 0.82 | −0.83 | 0.90 | −0.59 | 0.91 | −1.15 | 2.20 | +0.53 | 2.32 | +1.03 |
| 4,000 | | | | | 0.74 | −0.49 | 1.02 | −0.46 | 1.63 | +0.50 | 1.38 | +0.87 |
| 4,500 | | | | | 0.81 | −0.26 | | | 1.33 | +0.51 | 0.74 | |
| 5,000 | | | | | | | | | | | 0.16 | |

*Naval Air Station, Washington, D. C.

TABLE 2.—*Free-air resultant winds (m. p. s.) during November, 1927*

| Altitude m. s. l. (meters) | Broken Arrow, Okla. (253 meters) | | | | Due West, S. C. (217 meters) | | | | Ellendale, N. Dak. (444 meters) | | | | Groesbeck, Tex. (141 meters) | | | | Royal Center, Ind. (225 meters) | | | | Washington, D. C. (34 meters) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | 10-year mean | | Mean | | 7-year mean | | Mean | | 10-year mean | | Mean | | 10-year mean | | Mean | | 10-year mean | | Mean | | 7-year mean | |
| | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. | Dir. | Vel. |
| Surface | S. 33°W. | 1.5 | S. 42°W. | 1.5 | S. 53°W. | 0.5 | W. | 0.6 | N. 40°W. | 3.5 | N. 50°W. | 2.5 | S. 9°W. | 3.1 | S. | 0.3 | S. 48°W. | 3.6 | S. 46°W. | 2.4 | N. 87°W. | 0.7 | N. 55°W. | 1.4 |
| 250 | S. 33°W. | 1.5 | S. 41°W. | 1.6 | S. 42°W. | 0.6 | W. | 0.6 | | | | | S. 7°W. | 4.9 | S. 24°W. | 1.0 | S. 46°W. | 3.9 | S. 50°W. | 3.0 | S. 72°W. | 3.7 | N. 68°W. | 3.6 |
| 500 | S. 29°W. | 2.2 | S. 39°W. | 2.3 | S. 73°W. | 2.7 | S. 82°W. | 1.5 | N. 46°W. | 3.9 | N. 58°W. | 2.6 | S. 10°W. | 7.7 | S. 5°W. | 2.2 | S. 52°W. | 7.0 | S. 55°W. | 5.4 | S. 74°W. | 5.1 | N. 67°W. | 5.3 |
| 750 | S. 36°W. | 3.5 | S. 42°W. | 3.3 | S. 77°W. | 3.9 | S. 88°W. | 2.3 | N. 40°W. | 5.4 | N. 59°W. | 4.1 | S. 15°W. | 9.3 | S. 21°W. | 3.0 | S. 58°W. | 9.9 | S. 60°W. | 7.0 | N. 84°W. | 7.1 | N. 66°W. | 6.6 |
| 1,000 | S. 42°W. | 4.7 | S. 53°W. | 4.0 | S. 80°W. | 4.6 | S. 84°W. | 3.1 | N. 48°W. | 6.2 | N. 61°W. | 5.0 | S. 23°W. | 9.9 | S. 37°W. | 3.6 | S. 64°W. | 10.8 | S. 69°W. | 7.6 | N. 83°W. | 8.3 | N. 65°W. | 7.1 |
| 1,250 | S. 54°W. | 6.3 | S. 62°W. | 5.0 | S. 79°W. | 6.5 | S. 89°W. | 4.5 | N. 56°W. | 6.6 | N. 64°W. | 5.9 | S. 32°W. | 9.8 | S. 51°W. | 4.1 | S. 68°W. | 11.5 | S. 72°W. | 7.9 | | | | |
| 1,500 | S. 66°W. | 8.4 | S. 72°W. | 5.8 | S. 85°W. | 7.0 | S. 88°W. | 5.7 | N. 60°W. | 7.4 | N. 62°W. | 7.0 | S. 34°W. | 9.3 | S. 61°W. | 4.6 | S. 74°W. | 11.6 | S. 77°W. | 9.0 | N. 67°W. | 10.1 | N. 63°W. | 7.8 |
| 2,000 | S. 75°W. | 10.0 | S. 79°W. | 7.1 | N. 88°W. | 7.9 | S. 86°W. | 7.5 | N. 63°W. | 11.0 | N. 64°W. | 8.9 | S. 45°W. | 7.8 | S. 75°W. | 5.6 | S. 88°W. | 12.1 | S. 84°W. | 10.2 | N. 79°W. | 10.3 | N. 71°W. | 10.0 |
| 2,500 | S. 77°W. | 10.4 | S. 84°W. | 7.9 | S. 83°W. | 8.9 | S. 86°W. | 9.1 | N. 62°W. | 14.5 | N. 64°W. | 11.1 | S. 53°W. | 6.9 | S. 80°W. | 7.0 | S. 82°W. | 15.1 | S. 86°W. | 12.0 | N. 88°W. | 9.9 | N. 86°W. | 11.0 |
| 3,000 | S. 89°W. | 10.4 | S. 87°W. | 8.9 | S. 46°W. | 9.1 | S. 78°W. | 10.0 | N. 66°W. | 18.0 | N. 67°W. | 13.2 | S. 63°W. | 9.2 | S. 83°W. | 8.9 | N. 81°W. | 15.0 | N. 86°W. | 13.3 | N. 87°W. | 12.2 | N. 80°W. | 13.5 |
| 3,500 | S. 85°W. | 12.3 | S. 86°W. | 9.6 | S. 50°W. | 13.7 | S. 79°W. | 11.8 | N. 74°W. | 18.2 | N. 67°W. | 14.2 | S. 71°W. | 14.1 | S. 75°W. | 10.8 | N. 86°W. | 14.4 | N. 85°W. | 13.4 | N. 84°W. | 13.1 | N. 81°W. | 13.8 |
| 4,000 | S. 84°W. | 14.1 | S. 84°W. | 10.9 | S. 69°W. | 17.0 | S. 81°W. | 14.0 | W. | 21.0 | N. 68°W. | 13.8 | S. 70°W. | 15.0 | S. 72°W. | 9.1 | S. 88°W. | 15.8 | N. 88°W. | 13.5 | N. 80°W. | 14.6 | N. 75°W. | 14.8 |
| 4,500 | | | | | S. 68°W. | 21.0 | S. 81°W. | 15.1 | W. | 23.0 | N. 64°W. | 16.1 | W. | 19.0 | S. 70°W. | 11.0 | N. 85°W. | 17.3 | S. 88°W. | 13.9 | N. 86°W. | 14.9 | N. 76°W. | 15.5 |
| 5,000 | | | | | | | | | | | | | | | | | | | | | N. 78°W. | 14.7 | N. 72°W. | 16.4 |

# THE WEATHER IN THE UNITED STATES

## GENERAL CONDITIONS

Apart from the catastrophic floods in New England during the early days of November, the month was without important departures from normal conditions. The temperature for the country as a whole was decidely above the normal, the only exception being in the Dakotas, eastern Montana, and the northern parts of Minnesota and Wisconsin. Rainfall on the whole was deficient except in the flood-stricken part of New England and in parts of Pacific coast States. Snowfall was light and inconsequential.—*A. J. H.*

## THE WEATHER ELEMENTS

By P. C. DAY

### PRESSURE AND WINDS

The important features of the weather for November, 1927, were the unusual warmth and general lack of important precipitation in the Southern States, and the excessive precipitation and attending severe flood conditions in portions of New England and near-by areas.

The month as a whole was stormy over the far Northwest and cyclones were rather frequent and gave important precipitation in the area from the Great Lakes eastward.

Among the cyclones causing important precipitation over considerable areas may be mentioned that of the 3d and 4th which developed as a moderate depression over the east Gulf States and moved to New England by the 4th, developing greatly in severity as it moved northward and attended by heavy to excessive rains over the eastern portions of New York and the adjacent areas of New England. Total falls during the period from near sunset of the 3d to sunset of the 4th, the time of heaviest precipitation, ranged up to as much as 8 inches locally in parts of the storm area, and disastrous floods followed in the Connecticut River and some of its tributaries as well as elsewhere in the area of heavy precipitation, the details of which appear elsewhere in this issue.

A second important cyclone moved from western Montana on the 9th to eastern Iowa by the 10th and thence northeastward to beyond the Great Lakes during the following 24 hours. The precipitation was not particularly heavy but it covered a wide area from the Mississippi Valley eastward to the Appalachian Mountains and generally from New York to New England.

Another storm pursuing a similar course was central over eastern Iowa on the morning of the 15th, moving northeastward to beyond the Great Lakes during the following 24 hours. Before the effects of this storm had passed over the upper Mississippi Valley and lake region, another moderate barometric depression formed over the lower Mississippi Valley and moved northeastward over the Atlantic Coast States to New England by the morning of the 18th. This was attended by heavy rains over most of the Central and east Gulf States, Ohio Valley, and Atlantic Coast States. But little important precipitation occurred during the last decade over the central and eastern districts until near the end, when more or less precipitation occurred over most central and northern districts from the Mississippi Valley eastward.

Over the Pacific coast States precipitation was rather general on several dates during the first half, but during the remainder of the month it was confined chiefly to the more northern portions.

The most important anticyclone of the month entered the far Northwest on the morning of the 11th and moved rapidly southeastward to the Ohio Valley by the 13th, from where it drifted northeastward to New England. This brought temperature reductions of 20° to 40° over most districts in its movement eastward, though the line of freezing temperature did not extend as far southward over the central and eastern districts as on the 6th.

The average pressure for the month reduced to sea level was highest and considerably above normal over the southeastern districts, and it was distinctly low in the Rocky Mountain and Plateau regions.

The distribution of the pressure is graphically shown on Chart VI, and the departures from normal values and changes as compared with October are shown by the insets on Charts I and II.

Severe wind storms were rather infrequent for the last month of autumn and were confined largely to the middle period and near the end. A tornado causing important property damage, but without loss of life, occurred in the vicinity of Washington, D. C., on the 17th, the usual details of which appear elsewhere in this issue.

### TEMPERATURE

Rather important temperature changes occurred at intervals during the month, but on the whole warm weather was the rule over the greater part of the country and this was especially the case in the more southern sections.

The first week was mainly cool save for the first day or two over most eastern districts which were in numerous localities the warmest of the month. The remainder of the week was distinctly cool from the Rocky Mountains eastward, save over the more southern portions and in the far West, some of the lowest temperatures of the month occurring at the close.

The second week continued warm in the South and averaged warmer than normal over most other districts save from the upper Mississippi Valley westward where the middle and latter portions were distinctly cold, though the first few days were the warmest of the month over the Plains portion of this area.

The third week averaged warmer than normal from the Rocky Mountains westward and in the Northeastern States. Over the interior portions of the country this week was mainly cold and some of the lowest temperatures of the month were observed from the 16th to 18th in the central valleys and northern districts, the period being from 15° to 20° below normal in eastern Montana and the Dakotas.

The last week averaged warm over the entire country, though the first part had some of the coldest weather of the month in the Plateau and near-by districts and at the end it was again cold over the Rocky Mountain area. The average temperature for this week was unusually high over much of the country, and at a number of points in the Central and Eastern States the maximum readings on some of the last few days were the highest of record for so late in the fall.

The mean temperatures for the month were above normal over all parts of the country save in the northern sections from the Rocky Mountains eastward to the upper Mississippi Valley and Lake Superior region and to the northward into Canada, where it was a distinctly cold month.

Over southern districts from Texas eastward the month was mainly the warmest November of record, and somewhat less pronounced conditions existed over much of the Middle Atlantic Coast States. The extent of the temperature departures is shown on Chart III.

Minimum temperatures of 20° or more below zero were reported from North Dakota and Minnesota and they were nearly as low over some near-by areas and in the high elevations of the Rocky Mountain region. The first killing frosts of the season did not occur until about the 5th and 6th over a large portion of the great agricultural regions of the Central States, much later than usual and too late to do much damage as most crops had fully matured before that time.

### PRECIPITATION

There was a considerable deficiency in precipitation over the middle and southern Plains, particularly in the western portions of Kansas and thence southward to the Rio Grande, and severe drought continued in portions of the Southeastern States, notably in Florida where, locally it was the driest November of record and winter, truck was materially damaged or planting and germination delayed. In other portions of the country there was a very general excess of precipitation as compared with the normal fall for November, and it was generally well distributed through the month. Over an extensive area from the Great Lakes and Ohio Valley eastward it was decidedly wet and at many points in the lake region and from Pennsylvania northeastward to New England the monthly totals were the greatest ever known in November.

The general excess of precipitation from the Mississippi Valley eastward, except in some southeastern sections, assured a good supply of soil moisture, and similar conditions existed over the sections from the Rocky Mountains westward.

### SNOWFALL

No unusually heavy snows occurred, though in the northern tier of States from the Rocky Mountains to the Great Lakes snows were rather frequent and the total falls somewhat greater than normal.

In the western mountains there were rather heavy falls in portions of Wyoming and Colorado, but elsewhere snow was rather light due to the very general warmth. The extent of snowfall and the depths over the various areas are shown on Chart VII.

But little snow remained on the ground at the end of the month save in the higher mountains of the West.

### RELATIVE HUMIDITY

The amount of moisture in the atmosphere as shown by the average relative humidity was above normal over nearly all parts of the country, only a few localities, mostly in the central and southern Great Plains, showing averages less then normal. The averages were unusually high in the Plateau and some near-by portions of the Pacific Coast States.

### SUNSHINE AND CLOUDS

The month had a large excess of cloudly weather in the upper Mississippi Valley and near-by areas, where the number of cloudy days was far above normal and in many instances the greatest for November and in some the greatest for any month of record. Over many southern sections there was much clear weather.

## SEVERE LOCAL STORMS, NOVEMBER, 1927

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the annual report of the chief of bureau]

| Place | Date | Time | Width of path, yards [1] | Loss of life | Value of property destroyed | Character of storm | Remarks | Authority |
|---|---|---|---|---|---|---|---|---|
| Columbia, Mo | 1 | P. m. | | | $7,000 | Thunderstorm and hail. | Damage confined to window glass, roofs of houses and automobile tops; some loss to wire service companies. | Official, U. S. Weather Bureau. |
| Lower Lake Michigan area | 11 | | | | | Wind and severe thunderstorms. | Plate-glass windows broken; many houses damaged; power lines affected; lake traffic delayed. | Do. |
| Guthrie, Okla. (near) | 14 | 6 p. m. | 4 mi. | | 3,500 | Heavy hail | Roofs and crops badly damaged. | Do. |
| Caddo County, Okla. (southwest part). | 14 | 6 p. m. | 6 mi. | | 12,000 | do | Damage chiefly to crops over path 15 miles long. | Do. |
| Pensacola, Fla | 16 | 5 a. m. | | | 1,200 | Severe thunderstorm. | Roofs and windows damaged and wires disarranged over small area. | Do. |
| Harrisburg, Pa., and vicinity. | 17 | 1:45 p. m. | | | 20,000 | Electrical and wind. | Buildings and streets damaged. | Do. |
| Eastern Fairfax County, Va., to western Prince Georges County, Md. | 17 | 2:15-3 p. m | 16-200 | | 600,000 | Tornado | Many buildings damaged or completely demolished; 31 persons injured. | Do. |
| Yellow House to Spangsville, Pa. | 17 | 4:30-6 p.m. | | | 200,000 | Small tornado | One school house and several homes and farm buildings wrecked; bridge torn away. | Do. |
| Boulder, Colo., and vicinty. | 28 | | | | 15,000 | Wind | Windows broken; many small buildings blown down; houses and barns damaged; power and telephone lines twisted. | Do. |
| Grand Haven, Mich | 28 | | | | | do | Plant under construction wrecked; chimneys, garages, and other small buildings damaged. | Do |
| Tiffen, Ohio, and vicinity | 28 | | | | 5,000 | Tornadic wind and electricity. | One home severely damaged; other property damage in vicinity. | Do. |
| Cumberland, Md | 30 | P. m. | | | 20,000 | Gale | Glass factory wrecked; 3 airplanes badly damaged. | Do. |
| Lexington, Ky | 30 | | | | 25,000 | Severe thunderstorm. | Roofs, chimneys, telephone and telegraph lines damaged. | Do. |
| Parkersburg, W. Va | 30 | | | | | High wind | Wire systems damaged. | Do. |

[1] "Mi." signifies miles instead of yards.

## STORMS AND WEATHER WARNINGS

### WASHINGTON FORECAST DISTRICT

There were three storms of considerable intensity during the month. The first developed suddenly over Virginia and the Carolinas during the night of the 2d–3d, and by 8 a. m. of the 3d the barometer had fallen to 29.58 inches at Cape Hatteras. Southeast storm warnings were ordered displayed at 10 a. m. from New York City to Eastport, Me., and northwest storm warnings at 9 p. m. south of New York to Hatteras. By 8 a. m. of the 4th the pressure near the center of the storm had fallen to 29.08 inches at New Haven, Conn. Gales were experienced at all points from Hatteras northward, New York City reporting a maximum of 56 miles per hour from the northwest and Portland, Me., 52 miles per hour from the southeast.

Just two weeks after the first storm another was central near Wytheville, Va., moving northeastward with increasing intensity. At 9:30 a. m. southwest storm warnings were displayed from Cape Hatteras to Eastport, Me. This storm was also attended by shifting gales along the entire Atlantic seaboard north of Hatteras and by a small tornado in the vicinity of Washington, D. C. (See p. 499 of this REVIEW.) At New York City and Sandy Hook, N. J., the wind attained a velocity of 60 miles per hour from the south.

The only other storm of importance was that of November 30–December 1. A secondary disturbance of moderate intensity, that was central over southeastern Missouri the morning of the 30th, moved northeastward with great rapidity as well as with rapidly increasing intensity. By 8 p. m. the center was over northeastern New York, Northfield, Vt., reporting a barometer reading of 29.42 inches. New York City reported the highest wind velocity, 64 miles per hour from the northwest, but velocities in excess of 50 miles per hour occurred at Cape Henry, Atlantic City, Sandy Hook, Block Island, and Nantucket.

Because of the unusually mild weather during October, frost warnings were still required at the beginning of November throughout the district. Warnings for limited areas were issued on the 2d, 3d, 4th, and 5th, and general warnings for all sections, except the Florida Peninsula, on the 6th. By the 7th killing frost or freezing temperature had occurred quite generally as far south as Tennessee and the interior of North Carolina. On the 12th, 16th, 17th, 18th, 19th, and 20th warnings were issued for portions of the South Atlantic and east Gulf States, the heaviest frosts over a considerable area occurring on the 19th and 20th. No cold-wave warnings were issued during November, except for the extreme western portions of Kentucky and Tennessee and northwestern Ohio on the 30th.—*C. L. Mitchell.*

### CHICAGO FORECAST DISTRICT

The storms moved across the forecast district with more than the usual frequency, and in consequence a larger number of storm and small-craft warnings than usual were ordered for the Great Lakes.

Small-craft warnings took care of the vessel interests until the close of the first decade, as up to that time winds on the lakes were not dangerous for large vessels. However, a storm which developed in the Far West had by the 11th reached the upper Mississippi Valley and passed across the Greet Lakes on the 11th and 12th with steadily increasing energy and was followed by a cold wave of moderate proportions. Storm warnings were displayed at all stations on the Great Lakes for this storm, and cold-wave warnings were ordered on the morning of the 11th for the entire forecast district, the falls in temperature being from exceptionally high maxima for the season to something close to or below the seasonal normal.

Another storm immediately followed in the West, and on the 15th it passed over the Great Lakes. In this storm the strong winds were mainly confined to the upper Lakes region, where storm warnings were displayed, and small-craft warnings appeared to be sufficient for the lower Lakes as the storm in its movement eastward lost energy. However, by the 17th there was a redevelopment of a secondary disturbance in the South, and as it passed northeastward across the Appalachians with constantly increasing barometric gradient to the north over the lower Lakes, storm warnings in that area appeared to be justified, and these were ordered on the morning of the 17th from Cleveland eastward.

Following this storm small-craft warnings served all purposes on the Great Lakes until the closing days of month, when warnings were ordered on all lakes as a storm of considerable energy passed eastward from the Northwest accompanied by high winds and squalls and followed by another sharp fall in temperature.

Because of the unusual warmth in the Middle States during the month, thundersqualls appeared to be much more frequent than usual, and in Chicago a record of seven thunderstorms for the month of November was established.

Advices during the month were issued to various interests which call for special service. Forecasts for considerable periods in advance, for a week or more, are being made upon request, and these appear to be quite satisfactory on the whole.—*H. J. Cox.*

### NEW ORLEANS FORECAST DISTRICT

Moderate cold waves, for which ample and timely warnings were issued, overspread most northern and central sections on the 11th–12th, 14th–15th, and on November 30–December 1. These cold waves lost strength as they moved southeastward and the cold wave warnings issued on the 11th, 29th, and 30th were not fully verified in some northeastern and central localities, but pronounced temperature changes occurred, with minimum temperatures near the verifying limits.

Frost or freezing warnings were issued for northern or central areas on the 2d, 3d, 5th, 12th, 14th, and 15th, and for southern or southeastern areas on the 16th,17th, 18th, and 30th. Conditions occurred as forecast, except where cloudy weather prevailed in a few instances.

No storm warnings were issued or required, but small-craft warnings displayed on the Texas coast on the 16th and 30th and on the Louisiana coast on the 16th for fresh to strong northerly winds were justified.

A "norther" warning for shipping interests at Tampico, Mexico, was issued on the 16th and winds occurred as forecast.

A "fire-weather" warning for forested areas in Oklahoma was issued on the morning of the 25th, giving advance notice of strong winds, with fair weather, that occurred in the ensuing 24 to 36 hours.—*R. A. Dyke.*

### DENVER FORECAST DISTRICT

A rapid succession of LOWS moved from the north Pacific coast southeastward across the Rocky Mountain region during practically the entire month, while high

pressures persisted most of the time in western Canada east of the Continental Divide and on the extreme northeastern Rocky Mountain slope.

Warnings of moderate cold waves were issued as follows: North-central Arizona on the morning of the 1st, northeastern Colorado and southern Wyoming on the evening of the 10th, southeastern Colorado on the morning of the 14th, Wyoming and northeastern Colorado on the morning of the 20th, east of the Divide in southern Montana and Wyoming on the evening of the 20th, eastern Colorado on the morning of the 21st, eastern Colorado and southeastern Wyoming on the evening of the 21st, southeastern Colorado on the morning of the 22d, east of the divide in Montana on the morning of the 26th, and southwestern Utah on the morning of the 29th. Warning of a severe cold wave was issued on the evening of the 19th for that portion of Montana immediately east of the divide and on the morning of the 21st for Wyoming. As a rule, the warnings were verified.

Cold waves without warnings occurred in eastern Montana and northern Wyoming on the 10th–11th, in north-central Arizona on the 23d, in northeastern Montana on the 29th, and in southeastern Wyoming and portions of central and northeastern Colorado on the 30th.

As snow and strong northerly winds were indicated in southern Wyoming at the time of the evening forecast of the 10th, and rains, turning to snow, with fresh to strong westerly winds, becoming northerly, when the morning forecasts of the 20th were made, livestock warnings were included in the cold-wave warnings for that State. The warnings were justified.

For the benefit of aviation and livestock interests, warnings of strong winds were also issued for Wyoming and eastern Colorado or portions of this region on the 2d, 6th, 7th, 8th, 9th, 10th, 19th, 20th, 21st, 24th, and 25th, for Montana and Wyoming on the 25th, and for Montana, Wyoming, and northeastern Colorado on the 27th and 28th. These forecasts were generally verified.

Frost warnings were issued for south-central and southeastern Arizona on the 1st, 22d, 23d, and 30th. The warnings of the 22d and 30th were verified, but those of the 1st and 23d failed of verification, due to the failure of HIGHS which were then over the plateau to advance southward.—*J. M. Sherier.*

### SAN FRANCISCO FORECAST DISTRICT

The weather charts of the month showed that seven well-defined depressions crossed the coast line and passed into the interior and affected the weather over a part or the whole of this forecast district. Four of these depressions crossed the coast line north of Cape Flattery and three, those of the 6th, 9th and 12th, in their eastward movement crossed the coast line south of Cape Flattery and caused general rains over the southern parts of this forecast district.

The month was a stormy one over the northeast Pacific Ocean and as disturbances were detected over the ocean the issue of storm warnings became necessary, this occurring on a number of occasions, namely, for a part or the whole of the coast line, on the 1st, 8th, 11th, 12th, 15th, 18th, 22d, 26th, and 29th. The storm following the warning of the 18th was the severest of the month along the coast of Washington and Oregon, the wind reaching a velocity of 72 miles an hour at North Head and 82 miles an hour at Tatoosh Island during the night of the 18th. The storm of the 23d following the warning issued on the 22d was also severe, and, like that of the night of the 18th, caused distress to a number of vessels off the north coast. The other storms during the month were of only moderate severity, but in all instances the attending winds justified the issue of the storm warnings. The warning issued on the 22d was a warning for a whole gale and was equivalent to a hurricane warning.

Frost warnings were issued for northern California on the 22d, 23d, and 24th of the month, and for the northern parts of the forecast district as occasion demanded.—*E. H. Bowie.*

### RIVERS AND FLOODS

By H. C. FRANKENFIELD

Aside from the disastrous New England flood, which is discussed in full elsewhere in this REVIEW, there were no rises of importance during November. Such others as did occur were without damage, except as noted below for the Allegheny and Willamette Rivers. The rise in the Illinois, which continued into December, will be reported upon in the REVIEW for that month.

*Allegheny River.*—Over the drainage area of this stream the precipitation for the month was large, and moderate floods occurred on November 18 and again on November 27 and 28. At Lock No. 5, Freeport, Pa., water from the first rise cut into the left bank just below the dam and damaged the bank and adjacent property. The highway was undermined and washed away; also three houses on the opposite side of the highway. The damage amounted to about $15,000. Crest stages at Pittsburgh, Pa., were 21.4 feet at 10 a. m. November 19 and 23.1 feet at 8 a. m. November 29.

*Willamette River.*—Heavy rain on November 24 over the lower portion of the drainage area, where, owing to a previous excess of precipitation, the ground was saturated and the streams already unusually high for the season, caused a rise to above flood stage at Portland, Oreg., on the 26th. Thereafter further rains and high water in the Columbia River increased the Portland stage until, on the 29th, the crest of 17.5 feet was reached at 3 p. m. The damage was slight, except at Kelso, Wash., where it is reported that, due to overflow from Coweman Creek, part of the city was under water for several days. Some damage was done also to highways, bridges, and railroads along small streams. In Portland the flood warnings, which were ample and well verified, permitted the removal of property from threatened basements and docks, so that the losses were practically negligible.

| River and station | Flood stage | Above flood stages—dates | | Crest | |
|---|---|---|---|---|---|
| | | From— | To— | Stage | Date |
| ATLANTIC DRAINAGE | | | | | |
| Merrimac: | *Feet* | | | *Feet* | |
| Concord, N. H. | 10 | | | 12.2 | Nov. 5. |
| Manchester, N. H. | 8 | | | 11.2 | Do. |
| Connecticut: | | | | | |
| White River Junction, Vt. | 15 | 4 | 8 | 25.0 | Nov. 4. |
| Bellows Falls, Vt. | 12 | 7 | 7 | [1] 25.6 | Do. |
| Holyoke, Mass. | 9 | 4 | 8 | 14.8 | Nov. 5. |
| Hartford, Conn. | 16 | 4 | 10 | 29.0 | Nov. 6. |
| Hudson: | | | | | |
| Troy, N. Y. | 15 | 4 | 5 | 21.7 | Nov. 4. |
| Albany, N. Y. | 12 | 4 | 5 | 16.9 | Nov. 5. |
| Susquehanna: | | | | | |
| Oneonta, N. Y. | 12 | 4 | 5 | 13.2 | Nov. 4. |
| Bainbridge, N. Y. | 11 | 24 | 24 | 11.0 | Nov. 24. |
| Unadilla: New Berlin, N. Y. | 8 | | | 9.0 | Nov. 18. |
| GREAT LAKES DRAINAGE | | | | | |
| St. Joseph: Montpelier, Ohio | 10 | | | 14.0 | Nov. 20. |

[1] Estimated.

| River and station | Flood stage | Above flood stages—dates | | Crest | |
|---|---|---|---|---|---|
| | | From— | To— | Stage | Date |
| MISSISSIPPI DRAINAGE | | | | | |
| Allegheny: | *Feet* | | | *Feet* | |
| Lock No. 5, Freeport, Pa. | 24 | 18 | 18 | 24.5 | Nov. 18. |
| Lock No. 4, Natrona, Pa. | 24 | 29 | 29 | 24.2 | Nov. 29. |
| MISSISSIPPI DRAINAGE | | | | | |
| Tuscarawas: Gnadenhutten, Ohio | 9 | 29 | ------- | 10.4 | Nov. 30. |
| Wabash: Lafayette, Ind. | 11 | 30 | ------- | 15.3 | Do. |
| Tippecanoe: Norway, Ind. | 6 | 15 | 15 | 6.0 | Nov. 15. |
| | | 25 | 26 | 6.0 | Nov. 25–26. |
| | | 29 | (2) | 6.5 | Nov. 29. |
| Illinois: | | | | | |
| Morris, Ill. | 13 | 29 | (2) | 14.5 | Nov. 30. |
| Peru, Ill. | 14 | 18 | 23 | 14.2 | Nov. 19. |
| | | 29 | (2) | 17.7 | Nov. 30. |
| Henry, Ill. | 10 | 30 | (2) | 10.4 | Do. |
| Peoria, Ill. | 16 | 29 | (2) | ------- | |
| Meramec: | | | | | |
| Pacific, Mo. | 11 | 9 | 11 | 13.9 | Nov. 10. |
| Valley Park, Mo. | 14 | 9 | 9 | 14.0 | Nov. 9. |
| Bourbeuse: Union, Mo. | 12 | 10 | 10 | 12.9 | Nov. 10. |
| Black: Corning, Ark. | 11 | 17 | 24 | 11.8 | Nov. 19–21. |
| PACIFIC DRAINAGE | | | | | |
| Columbia: Vancouver, Wash. | 15 | 26 | (2) | 16.3 | Nov. 29. |
| Willamette: | | | | | |
| Oregon City, Oreg. | 12 | 27 | 27 | 12.0 | Nov. 27. |
| Portland, Oreg. | 15 | 26 | (2) | 17.5 | Nov. 29. |
| Santiam: Jefferson, Oreg. | 10 | 25 | 26 | [1] 15.0 | Nov. 25. |
| | | 28 | 29 | [1] 13.0 | Nov. 29. |

[1] Estimated. [2] Continued into December.

## MEAN LAKE LEVELS DURING NOVEMBER, 1927

By UNITED STATES LAKE SURVEY

[Detroit, Mich., December 3, 1927]

The following data are reported in the Notice to Mariners of the above date:

| Data | Lakes[1] | | | |
|---|---|---|---|---|
| | Superior | Michigan and Huron | Erie | Ontario |
| Mean level during November, 1927: | *Feet* | *Feet* | *Feet* | *Feet* |
| Above mean sea level at New York | 602.54 | 578.91 | 571.11 | 244.85 |
| Above or below— | | | | |
| Mean stage of October, 1927 | −0.19 | −0.19 | −0.21 | −0.14 |
| Mean stage of November, 1926 | +0.85 | +0.65 | −0.36 | −0.39 |
| Average stage for November, last 10 years | +0.48 | −0.68 | −0.53 | −0.44 |
| Highest recorded November stage | −0.97 | −4.01 | −2.56 | −2.97 |
| Lowest recorded November stage | +1.48 | +1.23 | +0.66 | +1.44 |
| Average departure (since 1860) of the November level from the October level | −0.16 | −0.26 | −0.26 | −0.24 |

[1] Lake St. Clair's level: In November, 1927, 573.78 feet.

## EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, NOVEMBER, 1927

By J. B. KINCHER

*General summary.*—Except in the flooded areas of the Northeast and in some other sections where moisture was needed, the first part of the month was generally favorable and farm work made satisfactory advance. It was still too dry in the Southeast and quite generally in the western portions of the Great Plains, including much of Texas and adjoining sections. In the Ohio, middle Mississippi, and lower Missouri Valleys the first general killing frost and freezing weather of the season occurred on November 6, considerably later than the average. Droughty conditions continued in the Southeast until the latter part of the second decade, when rainfall over southern sections, especially from eastern Texas and Arkansas eastward, was very beneficial in conditioning the soil and for winter grain crops. There was some damage to tender vegetation by frost in the northern portions of the Gulf States, but harm was not extensive, as crops had mostly matured.

Outside operations were retarded by heavy rains in the Northeast and work was practically at a standstill in the Central-Northern States between the Lake region and the Rocky Mountains because of cold and snow. During the last decade frequent rains or muddy fields were unfavorable for outdoor work in the upper Mississippi Valley and from the Ohio River northward and northeastward. The mildness and abundant moisture, however, caused rapid growth of winter crops and generally good condition was noted. Moisture was still needed in the Southeast, rather badly in places, while in the Southwest, including the western Great Plains, the drought was unrelieved with precipitation badly needed.

*Small grains.*—During the first decade light to moderate precipitation benefited winter wheat over much of the interior valleys and continued satisfactory progress was reported. It was still too droughty, however, in the extreme western portion of the belt and in much of the Southwest, particularly western Kansas and some adjoining sections. During the second decade light to moderate rainfall was beneficial for winter wheat in Oklahoma, but, in general, moisture was still needed and the crop made mostly poor progress in the Southwest. In other portions conditions were generally favorable and wheat made satisfactory advance, but in the Southeast the soil continued too dry for winter grains. Growth of winter wheat was checked in the interior valleys by cool weather the latter part of the decade.

The mild, moist conditions which prevailed quite generally throughout Central and Northern States from the eastern Great Plains eastward during the last decade made splendid growing conditions for wheat and other fall crops and satisfactory advance was reported. It was still too dry, however, in western portions of the Great Plains, particularly in western Kansas and some adjoining districts, and poor progress was made.

*Corn.*—Weather conditions during the first decade were generally favorable for drying out the corn crop and husking made good progress in the upper Ohio Valley, in Missouri, and quite generally in the Great Plains States, while considerable was accomplished in other portions of the belt. Husking was delayed by rains during the second decade in much of the Mississippi Valley, but in western portions of the Corn Belt and in the area from the upper Ohio Valley eastward good progress was made in this work.

During the last decade in the more eastern States from Pennsylvania and West Virginia northward, and also in the area lying north of the Ohio River, as well as in much of the upper Mississippi Valley, frequent showers or thawing weather made corn fields too soft for operations and husking made slow progress. Elsewhere good advance was reported under favorable weather conditions, especially in the Great Plains and Southwest, where the weather was unusually favorable.

*Cotton.*—Very favorable conditions for picking and ginning cotton continued throughout most of the first decade. Practically all upland cotton had been harvested in Tennessee, while in Arkansas killing frost stopped growth but caused bolls to open rapidly. Good progress was reported in Oklahoma, and ideal weather in Texas was very favorable for gathering the cotton remaining in the fields. During the second decade frequent rains interrupted pick-

ing in central sections, but elsewhere in the belt where harvest had not been completed the weather was favorable and good progress was made. The mild, dry weather during the last decade made conditions excellent for field work, and picking the remaining cotton crop made good advance. Practically all cotton had been picked in eastern Oklahoma, with a little top crop still being harvested in the lower Rio Grande Valley of Texas.

*Miscellaneous crops.*—Continued absence of sufficient rainfall in southern sections made conditions very unfavorable for pastures and they were generally poor. Ranges continued mostly good to excellent in the great western grazing areas, but lack of adequate moisture was detrimental in parts of the Southwest, particularly in southeastern New Mexico and western Texas. Livestock continued in fine shape generally, with only a little housing and feeding necessary.

Dry weather was very unfavorable for truck in the Southeast, with poor progress reported. Conditions in Louisiana were excellent for sugar cane, with quality reported high generally. Tobacco was casing well in Wisconsin at the close of the month, but stripping was awaiting colder weather. Citrus trees were wilting in Florida the latter part, and fruit was coloring slowly, due to warmth; cool weather was favorable in California, with rapid coloring reported.

## WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

### NORTH ATLANTIC OCEAN

By F. A. YOUNG

Taking the ocean as a whole, the number of days with unfavorable conditions was fully equal to, if not in excess of, the normal for November. Not only were the steamer lanes swept by frequent storms but disturbances were also encountered in southern waters.

Fog was reported on from seven to eight days over the Grand Banks and off the coast of Nova Scotia, and on from one to three days in European waters, while the middle section of the steamer lanes was comparatively clear. An unusual report of fog in southern waters was rendered by the Dutch S. S. *Waaldijk*, en route from Bahia to Las Palmas. On the 9th, while near the twenty-fifth parallel, between the twenty-fifth and thirtieth meridians, the ship encountered an intermittent and very wet fog.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, 8 a. m. (75th meridian), North Atlantic Ocean, November, 1927*

| | Average pressure | Departure [1] | Highest | Date | Lowest | Date |
|---|---|---|---|---|---|---|
| | *Inches* | *Inch* | *Inches* | | *Inches* | |
| Belle Isle, Newfoundland | 29.96 | +0.10 | 30.42 | 2d [2] | 29.32 | 30th. |
| Halifax, Nova Scotia | 30.15 | +0.15 | 30.78 | 14th | 29.40 | 6th. |
| Nantucket | 30.11 | +0.02 | 30.74 | 14th | 29.16 | 4th. |
| Hatteras | 30.19 | +0.07 | 30.52 | 13th | 29.58 | 3d. |
| Key West | 30.08 | +0.05 | 30.28 | 22d | 29.82 | 3d. |
| New Orleans | 30.16 | +0.05 | 30.42 | 20th | 29.90 | 16th. |
| Cape Gracias, Honduras | 29.85 | −0.05 | 29.94 | 22d | 29.76 | 29th. |
| Turks Island | 30.02 | +0.01 | 30.12 | 10th [2] | 29.82 | 3d. |
| Bermuda | 30.23 | +0.15 | 30.44 | 13th [2] | 29.48 | 4th. |
| Horta, Azores | 30.20 | +0.10 | 30.50 | 11th | 29.62 | 7th. |
| Lerwick, Shetland Islands | 29.82 | +0.12 | 30.42 | 30th | 29.10 | 5th. |
| Valencia, Ireland | 29.96 | +0.07 | 30.57 | 29th | 29.43 | 6th. |
| London | 29.96 | +0.02 | 30.50 | 26th | 29.30 | 7th. |

[1] From normals shown on Hydrographic Office Pilot Chart, based on observations at Greenwich mean noon, or 7 a. m., 75th meridian.
[2] And on other dates.

Charts VIII and IX show the conditions on the 1st and 2d, respectively, and give an idea of the progress of the extensive and severe disturbance that covered a large area of the ocean on October 31, as shown by Chart XI for that month. Charts VIII and IX also show the positions on the 1st and 2d of the disturbance that moved northeastward along the American coast during the early days of the month. This disturbance reached its greatest intensity on the 4th, when central near Nantucket, the storm area on that day extending from the thirtieth to forty-fifth parallel, west of the sixtieth meridian.

On the 5th a shallow depression was central near 32° N., 42° W. This moved slowly eastward, increasing in intensity. On the 8th the center was not far from Lisbon and moderate to strong gales prevailed in the vicinity of Madeira; it then passed into the Mediterranean, gradually filling in.

From the 5th to 10th there was also a disturbance over the eastern section of the northern steamer lanes. On the 7th and 8th the storm area extended as far west as the thirtieth meridian, while on the 9th and 10th the heavy weather was confined to the region east of the fifteenth meridian.

On the 10th there was a fairly severe disturbance off the coast of Nova Scotia that moved rapidly northeastward. From the 11th to 14th moderate weather prevailed over the ocean as a whole.

On the 15th a LOW was off the south coast of Greenland that afterwards developed into a severe disturbance as it moved eastward, with gales over the middle section of the steamer lanes. From the 20th to 22d the center of this LOW was near the English Channel; it then recurved sharply toward the north, and on the 24th was in the vicinity of Iceland.

On the 17th and 18th gales occurred along the American coast between Hatteras and New York.

On the 20th comparatively low pressure developed over the region between Porto Rico and the east coast of Cuba. Light winds were reported from that vicinity, but the force of the wind increased with a rising barometer and by the 23d reached a force of 7, with barometric readings well over 30 inches.

On the 24th and 25th the middle section of the steamer lanes was swept by strong gales that subsided as the accompanying LOW moved eastward. The center of this LOW on the 26th was near Iceland.

On the 26th a northerly gale prevailed in the western part of the Mediterranean, as shown by storm report from the British S. S. *Bloomfield*.

From the 27th to 30th there ensued another period of stormy weather over the eastern section of the steamer lanes, and on the 29th the northeast trades were stronger than usual, reaching a force of 7.

## OCEAN GALES AND STORMS, NOVEMBER, 1927

| Vessel | Voyage | | Position at time of lowest barometer | | Gale began | Time of lowest barometer | Gale ended | Lowest barometer | Direction of wind when gale began | Direction and force of wind at time of lowest barometer | Direction of wind when gale ended | Highest force of wind and direction | Shifts of wind near time of lowest barometer |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From— | To— | Latitude | Longitude | | | | | | | | | |
| **NORTH ATLANTIC OCEAN** | | | ° ′ | ° ′ | | | | *Inches* | | | | | |
| Thuringia, Ger. S. S. | Cobh | Boston | 49 12 N. | 30 07 W. | Nov. 1 | 6p., 1 | Nov. 2 | 28.67 | SW. | SW. | WNW. | SW., 11 | SW-W-WNW. |
| Goathland, Br. S. S. | St. Vincent | Gulfport | 25 00 N. | 60 00 W. | 2 | 6p., 2 | 4 | 29.60 | ENE. | ENE., 7 | WSW. | SW., 10 | ENE-S-SW. |
| Texas, Dan. S. S. | Newcastle | Boston | 58 15 N. | 19 00 W. | 2 | 3a., 2 | 3 | 28.57 | SE. | SE., 8 | W. | W., 12 | SE-W. |
| Persephone, Danzig S. S. | Hamburg | New York | 39 44 N. | 67 47 W. | 3 | 1p., 4 | 4 | 29.28 | ESE. | S., 8 | WSW. | SSE., 12 | ESE-S-WSW. |
| American Press, Am. S. S. | New Orleans | Glasgow | 51 30 N. | 22 00 W. | 5 | 4a., 5 | 6 | | NW. | NW., 8 | N. | NW., 10 | |
| George Peirce, Am. S. S. | Norfolk | Bremen | 41 45 N. | 54 45 W. | 4 | 3a., 6 | 6 | 29.62 | SSE. | SSE., 9 | S. | SSE., 9 | ESE-S. |
| Cherca, Ital. S. S. | New York | Genoa | 36 06 N. | 20 32 W. | 7 | 7p., 7 | 8 | 29.10 | NNE. | NNE., 6 | NW. | NNW., 9 | NNE-N-NW. |
| City of Alton, Am. S. S. | do | Rotterdam | 48 35 N. | 25 00 W. | 7 | 4a., 7 | 9 | 29.86 | NE. | NE., 7 | NE. | NE., 10 | Steady. |
| Prusa, Am. S. S. | Algeciras, Spain. | New Orleans | 34 24 N. | 16 29 W. | 7 | 4a., 8 | 8 | 29.17 | S. | W. | NW. | W., 10 | W-NW. |
| Texas, Dan. S. S. | Newcastle | Boston | 45 45 N. | 56 25 W. | 10 | 10a., 10 | 10 | 29.33 | ESE. | S., 8 | WNW. | NW., 12 | S-NW. |
| Berlin, Ger. S. S. | New York | Cherbourg | 45 42 N. | 39 52 W. | 16 | 4a., 16 | 16 | 30.08 | WNW. | W., 9 | NW. | NNW., 11 | NW-W-NNW. |
| Lorain, Am. S. S. | Hamburg | Boston | 43 00 N. | 23 00 W. | 16 | 6p., 16 | 18 | 29.94 | W. | W., 10 | NW. | W., 10 | SW-W. |
| Elzasier, Belg. S. S. | Antwerp | New York | 50 50 N. | 18 02 W. | 17 | 4a., 17 | 19 | 29.37 | S. | S., 7 | WNW. | NNW., 11 | S-NW. |
| Athelmere, Br. S. S. | New York | Cuba | 34 00 N. | 75 07 W. | 17 | 3a., 18 | 18 | 29.73 | S. | S., 10 | W. | SSW., 12 | S-SSW. |
| Australien, Dan. M. S. | Canal Zone | Hamburg | 27 40 N. | 80 45 W. | 18 | 6a., 19 | 19 | 29.75 | E. | E., 7 | SSE. | ESE., 9 | E-SE. |
| Manuel Calvo, Span. S. S. | Cadiz | Las Palmas | 34 28 N. | 8 35 W. | 19 | 4a., 19 | 20 | 29.45 | SW. | SW., 9 | NW. | SW., 9 | |
| Mayebashi Maru, Jap. S. S. | Canal Zone | New York | 17 37 N. | 75 02 W. | 21 | 4a., 21 | 23 | 29.76 | NNE. | NW., 6 | E. | NNE., 8 | Steady. |
| Demarara, Br. S. S. | Buenos Aires | Liverpool | 33 20 N. | 12 58 W. | 21 | 2p., 21 | 21 | 29.59 | W. | NW., 9 | NW. | NW., 9 | Do. |
| Arminco, Belg. S. S. | Newcastle | Marcus Hook | 48 10 N. | 31 18 W. | 22 | 11p., 22 | 23 | 29.62 | SSW. | NW., 6 | NW. | SW., 11 | |
| Argosy, Am. S. S. | Gothenburg | Portland, Me. | 58 30 N. | 4 45 W. | 23 | 8p., 23 | 30 | 29.06 | SSE. | SSE. | WSW. | SW., 10 | S-SW. |
| Orbis, Am. S. S. | Galveston | Liverpool | 45 00 N. | 45 30 W. | 23 | 4p., 24 | 26 | 29.41 | SW. | WSW., 8 | W. | WSW., 11 | SSW-NW. |
| Stockholm, Swed. S. S. | Gothenburg | New York | 51 24 N. | 42 36 W. | 25 | 3a., 25 | 28 | 28.62 | N. | NW., 8 | NNW. | NW., 11 | SW-N. |
| Bloomfield, Br. S. S. | Baytown | Marseille | 38 10 N. | 0 02 W. | 26 | 4p., 26 | 27 | 29.92 | N. | N., 8 | NNE. | N., 9 | Steady. |
| München, Ger. S. S. | Bremerhaven | New York | 49 51 N. | 25 27 W. | 27 | —, 27 | 28 | 29.55 | S. | WSW., 10 | NW. | —, 10 | SE-S-NW. |
| Kerbonkson, Am. S. S. | Liverpool | Baltimore | 47 42 N. | 43 09 W. | 30 | 3p., 30 | Dec. 1 | 29.76 | SSE. | SSW., 9 | W. | SSW., 9 | SSW-W. |
| **NORTH PACIFIC OCEAN** | | | | | | | | | | | | | |
| Yokohama Maru, Jap. S. S. | Yokohama | Victoria | 50 05 N. | 168 35 W. | Oct. 30 | 1a., 31 | Nov. 1 | 28.25 | E. | S., — | SW. | S., 12 | S-SSW. |
| Yeifuku Maru, Jap. S. S. | Nagasaki | Seattle | 45 21 N. | 163 02 E. | Nov 6 | 6p., 7 | 8 | 28.40 | ESE. | SW., 10 | W. | SW., 11 | Steady. |
| Kinkasan Maru, Jap. S. S. | Everett | Yokohama | 44 57 N. | 154 42 E. | 6 | 8a., 6 | 8 | 28.45 | E. | NE., 11 | N. | NE., 11 | E-NE-N. |
| West Cajoot, Am. S. S. | Yokohama | San Francisco | 41 34 N. | 154 00 E. | 6 | 2a., 6 | 8 | 28.83 | ESE. | SW., 10 | W. | SW., 11 | ESE-S-W. |
| Dewey, Am. S. S. | Otaru | do | 44 45 N. | 166 35 E. | 6 | 10p., 6 | 9 | 28.48 | ENE. | N., 12 | W. | N., 12 | ENE-N. |
| Wairuna, Br. S. S. | Suva, Fiji | Vancouver | 37 40 N. | 135 33 W. | 7 | 3a., 8 | 9 | 29.55 | NE. | N., 9 | N. | N., 9 | NE-N. |
| Montague, Am. S. S. | Manila | San Francisco | 33 00 N. | 141 12 E. | 8 | 8p., 8 | 9 | 29.52 | SE. | NE., 10 | N. | N., 11 | SE-NE. |
| Illingworth, Br. S. S. | Panama | Yokohama | 36 20 N. | 164 50 E. | 9 | 5a., 10 | 10 | 28.76 | SSE. | SW., 10 | NNW. | N., 12 | SW-W-N. |
| Yeifuku Maru, Jap. S. S. | Nagasaki | Seattle | 49 00 N. | 179 48 W. | 10 | Noon, 10 | 11 | 28.23 | ENE. | ESE., 2 | S. | SSW., 11 | E-ESE-SW. |
| Arizona Maru, Jap. S. S. | Yokohama | Victoria | 48 20 N. | 120 40 W. | 12 | 2a., 12 | 12 | 29.70 | | E., 8 | | E., 9 | 1 point. |
| Emp. of Russia, Br. S. S. | do | do | 49 15 N. | 127 30 W. | 11 | Noon, 13 | 13 | 29.36 | NNE. | ESE., 6 | ESE. | NNE., 9 | NNE-ESE |
| West Sequana, Am. S. S. | Hong Kong | San Francisco | 38 50 N. | 162 10 E. | 13 | 6p., 13 | 14 | 29.54 | SSE. | SSE., — | WNW. | S., 9 | |
| Koyo Maru, Jap. S. S. | Yokohama | Seattle | 49 37 N. | 131 00 W. | 14 | Noon, 15 | 16 | 29.81 | ENE. | SE., — | SSW. | SE., 9 | ENE-SE-SSW |
| Zurichmoor, Br. S. S. | Wei-hai-wei | Vancouver | 48 40 N. | 139 56 W. | 15 | Noon, 15 | 15 | 29.62 | ENE. | SE., 9 | SE. | SE., 9 | SE-SSE. |
| Sidney M. Hauptman, Am. S. S. | New York | San Pedro | 14 58 N. | 93 55 W. | 17 | 4p., 17 | 18 | 29.74 | NW. | NW., 6 | NE. | NE., 10 | NW-NE. |
| West Sequana, Am. S. S. | Hong Kong | San Francisco | 39 10 N. | 176 00 W. | 17 | Noon, 17 | 18 | 29.80 | SE. | SE., 8 | SE. | SE., 9 | Steady. |
| Aorangi, Br. S. S. | Victoria | Honolulu | 43 25 N. | 134 41 W. | 18 | 2p., 18 | 18 | 29.06 | SE. | WNW., 12 | NW. | WNW., 12 | SE-WSW. |
| Nora, Am. S. S. | San Pedro | Balboa | 15 12 N. | 95 06 W. | 19 | 4p., 19 | 19 | 29.91 | ENE. | N., 9 | NNW. | N., 9 | NE-NNE-N. |
| Savoia, Ital. S. S. | Balboa | Portland | 47 06 N. | 124 30 W. | 18 | 11p., 18 | 19 | 29.40 | ESE. | ESE., 9 | SW. | ESE., 11 | ESE-SE. |
| Montague, Am. S. S. | Manila | San Francisco | 39 42 N. | 178 55 W. | 18 | 2 a., 18 | 19 | 29.93 | SE. | SE., 9 | S. | SE., 9 | SE-S. |
| West O'Rowa, Am. S. S. | Orient | Portland | 49 30 N. | 137 00 W. | 20 | —, 21 | 22 | 29.52 | WSW. | SSW., 9 | WNW. | SSW., 10 | SSW-WNW. |
| Kaga Maru, Jap. S. S. | Yokohama | Victoria | 50 10 N. | 173 50 W. | 23 | 6a., 23 | 26 | 28.60 | NE. | E., 2 | S. | E., 11 | E-SSE-SSW. |
| Pres. Pierce, Am. S. S. | San Francisco | Yokohama | 33 10 N. | 166 27 E. | 24 | Mdt. 24 | 26 | 29.35 | W. | W., 9 | NNW. | NNW., 10 | W-WNW. |
| Protesilaus, Br. S. S. | Yokohama | Victoria | 47 24 N. | 174 52 E. | 25 | 2a., 25 | 28 | 28.57 | SSE. | SSW. | —. | 0 | ESE-SW. |
| Paris Maru, Jap. S. S. | do | Vancouver | 45 11 N. | 137 12 W. | 29 | 8p., 29 | 30 | 28.42 | S. | S., 8 | SW. | S., 9 | S-SW. |

## NORTH PACIFIC OCEAN

By WILLIS E. HURD

While the average pressure over Aleutian and Alaskan waters was much above the normal, yet there were three periods of intense development of the Aleutian LOW during November, 1927. One occurred on the 1st and 2d of the month in the Gulf of Alaska. The second took place over the central Aleutian Islands on the 10th and 11th, and the third covered much of the entire region from the 20th to the end of the month. Vessel reports show that winds as high as force 11 occurred in connection with these phases of the LOW on the 10th, 11th, and 25th in the neighborhood of 50° N., between the one hundred and eightieth meridian and 170° W. Very low pressures accompanied the developments, especially on the 1st, when a reading of 28.44 inches was made at Kodiak, and on the 11th, when one of 28.23 inches was reported by the Japanese steamer *Yeifuku Maru*, in 49° N., 179° 48′ W. In middle latitudes pressures were practically normal, and the great North Pacific anticyclone showed good development over two-thirds of the month and was never wholly dispossessed.

The following table gives pressure data for several island and coast stations in west longitudes:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, November, 1927*

| Stations | Average pressure | Departure from normal | Highest | Date | Lowest | Date |
|---|---|---|---|---|---|---|
| | *Inches* | *Inch* | *Inches* | | *Inches* | |
| Dutch Harbor [1 2] | 29.83 | +0.24 | 30.42 | 5th | 29.04 | 1st. |
| St. Paul [1 3] | 29.95 | +0.33 | 30.44 | 4th | 29.38 | 12th. |
| Kodiak [1 3] | 29.79 | +0.25 | 30.42 | 11th | 28.44 | 1st. |
| Midway Island [1] | 29.98 | −0.09 | 30.22 | 3d | 29.78 | 25th. |
| Honolulu [4] | 29.99 | −0.04 | 30.11 | 11th | 29.84 | 3d. |
| Juneau [4] | 29.86 | +0.10 | 30.49 | 11th | 28.93 | 26th. |
| Tatoosh Island [4 5] | 29.91 | −0.06 | 30.35 | 2d | 29.21 | 19th. |
| San Francisco [4 5] | 30.10 | 0.00 | 30.38 | 16th | 29.76 | 9th. |
| San Diego [4 3] | 30.02 | +0.02 | 30.17 | 2d | 29.76 | 1st. |

[1] P. m. observations only.
[2] For 29 days.
[3] For 28 days.
[4] A. m. and p. m. observations.
[5] Corrected to 24-hour mean.

Three important cyclonic areas developed in the region usually occupied by the NE. Pacific HIGH. The first appeared northeast of the Hawaiian Islands on the 6th.

It intensified on the 7th and 8th, giving rough weather to steamers midway on the Honolulu-California routes, then with less energy entered the coast south of Oregon on the 9th. The second developed near 40° N., 145° W., on the 10th and entered the Washington coast on the 14th, where it quickly died out. It caused high gales, especially in coastal waters, attaining storm force at times on the 12th. The third appeared near 43° N., 138° W., on the 18th and, quickly spreading eastward, caused severe local gales which attained storm to hurricane force in places at sea and off the coast between North Head and Victoria.

Tatoosh Island, Wash., reported winds of 70 or more miles an hour as follows: 73 E. on the 12th, 70 E. on the 15th, 75 S. on the 19th, and 79 S. on the 22d.

In east longitudes storm to hurricane winds occured over a great extent of sea between Japan and 170° E. on the 6th, 7th, and 8th, in connection with an intense cyclone that had its origin in China as a mere depression on the 3d. Hurricane velocities also occurred on the 10th in the vicinity of 35° N., 165° E.

There were no cyclones in Mexican coast waters this month. Strong to severe northers, however, blew over the Gulf of Tehuantepec on several days, attaining the force of a whole gale on the 17th.

The prevailing wind direction at Honolulu was from the east, with konas occurring on four days. The maximum velocity was at the rate of 32 miles an hour from the northeast on the 17th.

Fog was more prevalent than usual for the month in middle latitudes from the one hundred and eightieth meridian to the American coast, and on several days during the last decade extended as a vast though broken sheet between these boundaries, especially along the fortieth to forty-fifth parallels. There was more fog than usual over the eastern half of the Honolulu-California routes, and also, for this time of year, to the south and southwest of the Aleutian Islands.

NOTE.—In the review of North Pacific weather for August, 1927, it was noted that a moderately intense cyclone occurred off the Mexican west coast from the 7th to the 10th. A recently received report from Capt. G. S. Dexter, of the American steamer *Chilsco*, shows that the storm was much more violent than had previously been suspected, as this vessel encountered hurricane winds, first from the north, then from the southwest, on the 9th, while in and near 17° 47′ N., 106° 21′ W. Captain Dexter observed that "it gave much less warning than the hurricanes do in the Atlantic and Caribbean Sea."

### CYCLONE OF THE ARABIAN SEA

Mr. B. C. Jackson, chief officer and observer of the British S. S. *Khosrou*, Capt. F. Beattie, Calcutta to Karachi, reports that on November 12, 1927, the *Khosrou* was involved in a tropical cyclone of some intensity, the highest wind force experienced being 10, from the NE. by N., in 19° 30′ N., 70° 15′ E. According to official radio reports received from Colombo and Bombay by this vessel, the storm originated on the 11th near 13° N., 66° E., and was heading in a northeasterly direction. It intensified on the following day, when central near 17° N., 70° E., and on the morning of the 13th, now traveling east-northeast, passed into the Indian coast about 60 miles south of Bombay.

## TYPHOONS AND DEPRESSIONS

### TWO TYPHOONS IN THE FAR EAST IN NOVEMBER, 1927

By Rev. José CORONAS, S. J.

[Weather Bureau, Manila, P. I.]

There were only two well-developed typhoons in the Far East during November. Both were formed and remained in the Pacific, only one of them having influenced the weather of the Philippines.

The first of these typhoons was probably formed on the 17th to 18th about 200 miles to the west of Guam. It moved westward until the early morning of the 21st, when it inclined northwestward about 200 miles to the east of San Bernardino Strait. In the early morning of the 22d it recurved to ENE. 120 miles to the east of northern Luzon.

The second typhoon was shown on our weather map of the 24th, 6 a. m., to the SSE. of Guam near 146° longitude E. between 6° and 7° latitude N. It moved WNW. and passed close to the south of Yap, where winds from the northeast quadrant, force 9 to 10, were observed. We do not know as yet the barometric minimum recorded in that station. The center must have passed at about 11 a. m. of the 25th. From the early morning of that day the typhoon was inclining gradually more and more to the north until in the afternoon of the 26th and on the 27th it moved practically northward. The United States Army transport *Thomas* was about 50 miles to the east of the center, the winds blowing with force 7 to 8 from the east quadrants, and the barometric minimum being 29.42 inches (747.27 millimeters), gravity correction not applied, at 4 p. m. of the 26th.

Lack of sufficient observations prevents us from giving as certain the track of this typhoon after the 27th, but it would seem probable that it was the same that appeared west of the Bonins on the 29th, and, therefore, it must have inclined to NNE. on the 28th and northeast on the 29th, when it passed 150 miles to the northwest of the Bonins.

## CLIMATOLOGICAL TABLES[1]

### CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

*Condensed climatological summary of temperature and precipitation by sections, November, 1927*

| Section | Temperature | | | | | | | Precipitation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section average | Departure from the normal | Monthly extremes: Station | Highest | Date | Station | Lowest | Date | Section average | Departure from the normal | Greatest monthly: Station | Amount | Least monthly: Station | Amount |
| | °F. | °F. | | °F. | | | °F. | | In. | In. | | In. | | In. |
| Alabama | 60.5 | +6.4 | Selma | 88 | [2]25 | St. Bernard | 24 | 20 | 3.66 | +0.60 | Scottsboro | 9.11 | Ozark | 0.46 |
| Arizona | 56.3 | +3.9 | Camel Back | 92 | 4 | 2 stations | 9 | 23 | 0.28 | −0.65 | Nadaburg | 1.35 | 24 stations | 0.00 |
| Arkansas | 56.7 | +5.1 | Dumas | 96 | 1 | 2 stations | 20 | [2]17 | 3.67 | +0.02 | Little Rock | 8.18 | Danville | 0.93 |
| California | 53.7 | +1.3 | Tustin (near) | 96 | 17 | Helm Creek | −2 | 22 | 3.65 | +1.19 | Crescent City | 21.30 | 4 stations | 0.00 |
| Colorado | 38.9 | +4.1 | 2 stations | 90 | 10 | Dillon | −18 | 30 | 0.99 | +0.18 | Fraser | 3.64 | 4 stations | T. |
| Florida | 67.9 | +2.9 | 2 stations | 90 | 1 | Vernon | 28 | 20 | 1.19 | −1.06 | Garniers | 6.16 | Hilliard | 0.00 |
| Georgia | 59.5 | +5.0 | 2 stations | 88 | [2]1 | Blue Ridge | 19 | 20 | 1.61 | −1.04 | 2 stations | 5.50 | Savannah | 0.40 |
| Idaho | 39.4 | +3.5 | Chattins Flat | 76 | 6 | Obsidian | −10 | 23 | 4.69 | +2.52 | Roland | 15.56 | Dubois | 0.40 |
| Illinois | 45.9 | +3.8 | 4 stations | 82 | 1 | Marengo | 12 | 18 | 4.64 | +2.22 | Hoopeston | 7.38 | Galena | 1.55 |
| Indiana | 47.0 | +4.8 | Vincennes | 81 | 1 | Brookville | 12 | 19 | 5.71 | +2.62 | Hickory Hill | 8.70 | Decker | 2.93 |
| Iowa | 37.7 | +1.1 | 3 stations | 81 | [2]9 | Sanborn | 0 | 18 | 0.87 | −0.69 | Keokuk | 3.61 | 2 stations | T. |
| Kansas | 44.8 | +0.8 | 2 stations | 89 | 10 | Oberlin | 6 | 16 | 0.44 | −0.72 | Walnut | 3.15 | 5 stations | T. |
| Kentucky | 51.3 | +5.0 | 3 stations | 82 | 1 | Farmers | 13 | 7 | 5.01 | +1.48 | Greensburg | 7.95 | Lockport | 2.68 |
| Louisiana | 65.3 | +6.4 | 2 stations | 91 | [2]2 | 2 stations | 28 | 18 | 3.62 | +0.04 | New Iberia | 8.33 | Grand Cane | 0.56 |
| Maryland-Delaware | 49.9 | +5.3 | 4 stations | 79 | [2]2 | Friendsville, Md. | 9 | 20 | 2.86 | +0.32 | Wilmington, Del. | 5.20 | Picardy, Md. | 1.54 |
| Michigan | 33.4 | +2.1 | Bad Axe | 79 | 1 | Iron River (near) | −15 | 19 | 4.30 | +1.92 | Hastings | 7.54 | Mount Pleasant | 1.37 |
| Minnesota | 25.6 | −4.3 | Canby | 71 | 10 | Itasca State Park | −21 | 30 | 1.21 | +0.13 | Cloquet | 2.88 | Fosston | 0.20 |
| Mississippi | 61.6 | +6.7 | 2 stations | 91 | [2]1 | 2 stations | 26 | 18 | 4.49 | +0.96 | Macon | 8.48 | Bay St. Louis | 1.82 |
| Missouri | 46.8 | +2.3 | Warrenton | 89 | 29 | 2 stations | 12 | [2]7 | 3.55 | +1.20 | Rolla | 7.89 | Albany | 0.08 |
| Montana | 29.2 | −2.6 | Sentinel Butte Pass | 74 | 25 | 3 stations | −20 | [2]16 | 2.24 | +1.43 | Haugan | 10.01 | Glendive | 0.30 |
| Nebraska | 37.9 | +1.2 | Haigler | 87 | 10 | Madrid | 0 | 30 | 0.29 | −0.45 | Chadron | 1.06 | 2 stations | 0.00 |
| Nevada | 45.3 | +5.0 | Las Vegas | 86 | [2]4 | Millett | −2 | 28 | 0.82 | +0.19 | Mahoney Ranger Station. | 3.73 | 2 stations | 0.00 |
| New England | 42.5 | +4.6 | 2 stations | 76 | 2 | Pittsburg (a), N. H. | 4 | 21 | 6.80 | +3.27 | Somerset, Vt. | 14.54 | Portland, Me. | 3.00 |
| New Jersey | 47.9 | +5.0 | Bridgeton | 83 | 2 | Runyon | 15 | 20 | 4.02 | +0.94 | Charlotteburg | 8.68 | Bridgeton | 1.74 |
| New Mexico | 47.6 | +4.7 | Carlsbad | 91 | 5 | Elizabethtown | −7 | 30 | 0.11 | −0.50 | Dulce | 1.35 | 54 stations | 0.00 |
| New York | 42.3 | +4.7 | Cortland | 77 | 1 | 2 stations | 8 | [2]8 | 7.38 | +4.51 | Allegany State Park | 11.92 | Booneville | 3.63 |
| North Carolina | 57.6 | +4.1 | Chadbourn | 84 | 16 | Mount Mitchell | 11 | 6 | 2.60 | +0.11 | Highlands | 7.26 | McHenrys Bridge | 0.65 |
| North Dakota | 20.7 | −5.9 | Berthold Agency | 59 | 3 | 2 stations | −24 | 17 | 0.70 | +0.12 | Mandan | 1.56 | 2 stations | 0.17 |
| Ohio | 46.6 | +5.1 | Waverly | 87 | 1 | McArthur | 13 | [2]7 | 6.07 | +3.41 | Delaware | 8.99 | Greenville | 2.51 |
| Oklahoma | 55.1 | +4.4 | Beaver | 94 | 10 | 2 stations | 12 | [2]17 | 1.02 | −1.07 | Cleveland | 4.23 | 4 stations | 0.00 |
| Oregon | 44.9 | +3.4 | Pilot Rock | 81 | [2]27 | Blitzen | −3 | 22 | 6.87 | +1.73 | Valsetz | 27.19 | Fremont | 0.68 |
| Pennsylvania | 46.2 | +5.2 | Clearfield | 85 | 1 | 2 stations | 10 | [2]8 | 4.95 | +2.14 | Bradford | 11.36 | Harrisburg | 2.21 |
| South Carolina | 57.2 | +3.6 | 2 stations | 84 | 1 | Santuck | 22 | 21 | 1.45 | −0.84 | Caesars Head | 5.58 | Beaufort (near) | 0.43 |
| South Dakota | 29.3 | −4.1 | Winner | 76 | 10 | 2 stations | −10 | 18 | 0.61 | −0.04 | Milbank | 1.55 | Strool | T. |
| Tennessee | 53.6 | +5.2 | 4 stations | 84 | [2]1 | 2 stations | 15 | [2]19 | 4.40 | +0.83 | Rugby | 8.72 | Rogersville | 2.15 |
| Texas | 64.4 | +7.3 | Harlingen | 97 | 30 | 2 stations | 18 | [2]16 | 0.58 | −1.76 | Conroe | 3.90 | 59 stations | 0.00 |
| Utah | 42.3 | +4.9 | Smithfield (near) | 80 | 6 | Woodruff | −1 | 23 | 1.64 | +0.63 | Silver Lake | 7.76 | 2 stations | 0.00 |
| Virginia | 50.8 | +4.8 | Lincoln | 86 | 24 | 2 stations | 15 | 20 | 2.83 | +0.48 | Columbia | 4.99 | Quantico | 1.27 |
| Washington | 40.4 | +1.2 | Sunnyside | 76 | 3 | Stockdill Ranch | 7 | 22 | 8.25 | +2.82 | Cougar | 31.44 | Wapato | 0.90 |
| West Virginia | 48.1 | +5.3 | White Sulphur Springs. | 82 | 1 | Pickens | 7 | 7 | 4.35 | +1.73 | St. Marys | 7.61 | Upper Tract | 0.91 |
| Wisconsin | 33.0 | −0.5 | Milwaukee (Airport) | 74 | 1 | Florence | −12 | 19 | 2.56 | +0.71 | Port Washington | 4.25 | 2 stations | 1.12 |
| Wyoming | 34.8 | +3.0 | Pinebluff | 74 | 10 | 2 stations | −12 | 30 | 1.17 | +0.57 | Moran | 4.52 | Diversion Dam | T. |
| Alaska (October) | 33.0 | −3.0 | Sitka | 61 | 2 | 2 stations | −18 | [2]20 | 7.03 | −0.04 | Latouche | 25.96 | Fort Yukon | 0.30 |
| Hawaii | | | | | | | | | | | | | | |
| Porto Rico | 77.5 | +0.6 | 2 stations | 96 | 4 | 2 stations | 58 | 2 | 9.88 | +2.67 | Rio Grande | 23.39 | Yauco | 1.30 |

[1] For description of tables and charts, see REVIEW, 43.
[2] Other dates also.

TABLE I.—*Climatological data for Weather Bureau stations, November, 1927*

| District and station | Elevation of instruments: Barometer above sea level | Elevation of instruments: Thermometer above ground | Elevation of instruments: Anemometer above ground | Pressure: Station, reduced to mean of 24 hours | Pressure: Sea level, reduced to mean of 24 hours | Pressure: Departure from normal | Temperature of the air: Mean max. + mean min. ÷2 | Temperature of the air: Departure from normal | Temperature of the air: Maximum | Temperature of the air: Date | Temperature of the air: Mean maximum | Temperature of the air: Minimum | Temperature of the air: Date | Temperature of the air: Mean minimum | Temperature of the air: Greatest daily range | Mean wet thermometer | Mean temperature of the dew point | Mean relative humidity | Precipitation: Total | Precipitation: Departure from normal | Precipitation: Days with 0.01, or more | Wind: Total movement | Wind: Prevailing direction | Wind: Maximum velocity: Miles per hour | Wind: Maximum velocity: Direction | Wind: Maximum velocity: Date | Clear days | Partly cloudy days | Cloudy days | Average cloudiness, tenths | Total snowfall | Snow, sleet, and ice on ground at end of month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Ft.* | *Ft.* | *Ft.* | *In.* | *In.* | *In.* | °F. | °F. | °F. | | °F. | °F. | | °F. | °F. | °F. | °F. | % | *In.* | *In.* | | *Miles* | | | | | | | | *0–10* | *In.* | *In.* |
| ***New England*** | | | | | | | **45.0** | **+5.5** | | | | | | | | | | **81** | **5.81** | **+2.2** | | | | | | | | | | **6.9** | | |
| Eastport | 76 | 67 | 85 | 29.97 | 30.06 | +0.05 | 41.5 | +4.8 | 65 | 1 | 48 | 19 | 21 | 35 | 20 | 39 | 36 | 82 | 5.03 | +1.0 | 18 | 9,221 | s. | 52 | se. | 4 | 5 | 4 | 21 | 7.7 | 1.6 | 0.0 |
| Greenville, Me | 1,070 | 6 | ---- | 28.85 | 30.04 | ------ | 35.6 | ------ | 66 | 1 | 43 | 12 | 21 | 28 | 30 | ---- | ---- | ---- | 6.20 | ------ | 15 | 6,249 | se. | 36 | ------ | 17 | 6 | 2 | 22 | ---- | 6.2 | ---- |
| Portland, Me | 103 | 82 | 117 | 29.96 | 30.09 | +.08 | 42.4 | +4.4 | 67 | 16 | 49 | 22 | 21 | 36 | 25 | 39 | 36 | 80 | 3.06 | −0.7 | 14 | 7,188 | sw. | 52 | se. | 4 | 6 | 6 | 18 | 7.2 | 3.5 | 0.0 |
| Concord | 289 | 70 | 79 | 29.74 | 30.06 | .00 | 42.3 | +4.6 | 72 | 2 | 51 | 18 | 20 | 33 | 35 | ---- | ---- | ---- | 6.07 | +2.7 | 12 | 3,923 | nw. | 27 | se. | 4 | 6 | 11 | 13 | 6.4 | 2.0 | 0.0 |
| Burlington | 408 | 11 | 48 | 29.58 | 30.03 | −.02 | 39.4 | +3.1 | 69 | 2 | 46 | 20 | 10 | 33 | 28 | ---- | ---- | ---- | 10.13 | +7.6 | 20 | 11,075 | s. | 48 | s. | 16 | 1 | 5 | 24 | 9.0 | 6.3 | 0.0 |
| Northfield | 876 | 12 | 60 | 29.08 | 30.05 | .00 | 38.6 | +5.8 | 70 | 2 | 48 | 15 | 9 | 30 | 33 | 35 | 34 | 87 | 11.42 | +8.8 | 23 | 5,920 | s. | 48 | sw. | 12 | 1 | 8 | 21 | 8.0 | 8.3 | 0.0 |
| Boston | 125 | 115 | 188 | 29.94 | 30.08 | +.03 | 49.6 | +7.6 | 76 | 2 | 58 | 26 | 20 | 42 | 30 | 44 | 40 | 76 | 4.71 | +0.6 | 11 | 7,876 | sw. | 33 | s. | 18 | 4 | 13 | 13 | 6.5 | 0.5 | 0.0 |
| Nantucket | 12 | 14 | 90 | 30.09 | 30.10 | +.05 | 49.2 | +4.8 | 67 | 2 | 55 | 29 | 20 | 43 | 21 | 46 | 43 | 82 | 3.11 | −0.2 | 11 | 12,673 | sw. | 44 | se. | 4 | 6 | 15 | 9 | 5.9 | T. | 0.0 |
| Block Island | 26 | 11 | 46 | 30.06 | 30.06 | +.02 | 48.9 | +4.3 | 66 | 2 | 54 | 30 | 20 | 44 | 26 | 46 | 43 | 82 | 4.66 | +0.8 | 8 | 14,204 | s. | 48 | nw. | 7 | 6 | 10 | 14 | 6.2 | 0.0 | 0.0 |
| Providence | 160 | 215 | 251 | 29.92 | 30.09 | +.02 | 48.0 | +7.6 | 72 | 1 | 56 | 25 | 20 | 40 | 31 | 44 | 40 | 76 | 3.11 | −0.8 | 11 | 9,799 | s. | 64 | se. | 4 | 6 | 13 | 11 | 5.9 | T. | 0.0 |
| Hartford | 189 | 122 | ---- | 29.92 | 30.10 | +.02 | 47.1 | +7.6 | 74 | 1 | 55 | 27 | 20 | 40 | 27 | ---- | ---- | ---- | 5.85 | +2.0 | 12 | ------ | sw. | ---- | ---- | ---- | 7 | 10 | 13 | 6.3 | T. | 0.0 |
| New Haven | 106 | 74 | 152 | 29.99 | 30.11 | +.04 | 47.6 | +7.6 | 71 | 1 | 55 | 25 | 20 | 40 | 27 | 43 | 40 | 80 | 6.71 | +3.1 | 11 | 6,838 | sw. | 41 | s. | 17 | 3 | 11 | 16 | 7.0 | T. | 0.0 |
| ***Middle Atlantic States*** | | | | | | | **49.2** | **+4.5** | | | | | | | | | | **77** | **3.27** | **+0.4** | | | | | | | | | | **6.2** | | |
| Albany | 97 | 102 | 115 | 29.96 | 30.07 | −.01 | 44.2 | +4.9 | 70 | 2 | 51 | 26 | 20 | 38 | 25 | 41 | 38 | 80 | 6.93 | +4.1 | 16 | 6,460 | s. | 37 | s. | 30 | 7 | 9 | 14 | 6.5 | T. | 0.0 |
| Binghamton | 871 | 10 | 84 | 29.12 | 30.07 | −.02 | 43.0 | +4.3 | 72 | 1 | 51 | 22 | 8 | 35 | 31 | ---- | ---- | ---- | 4.72 | +2.4 | 16 | 4,974 | w. | 40 | sw. | 17 | 3 | 7 | 20 | 7.9 | 2.2 | 0.0 |
| New York | 314 | 414 | 454 | 29.77 | 30.11 | +.02 | 48.6 | +4.4 | 70 | 23 | 55 | 28 | 20 | 42 | 26 | 44 | 40 | 77 | 3.95 | +0.5 | 14 | 13,557 | sw. | 62 | s. | 17 | 5 | 12 | 13 | 6.9 | T. | 0.0 |
| Harrisburg | 374 | 94 | 104 | 29.73 | 30.14 | +.03 | 47.1 | +4.3 | 71 | 1 | 54 | 26 | 20 | 40 | 26 | 43 | 39 | 77 | 2.21 | −0.1 | 12 | 5,019 | nw. | 42 | sw. | 17 | 3 | 10 | 17 | 7.2 | 0.4 | 0.0 |
| Philadelphia | 114 | 123 | 182 | 30.01 | 30.14 | +.04 | 50.9 | +5.2 | 73 | 2 | 58 | 28 | 20 | 43 | 22 | 46 | 42 | 77 | 3.59 | +0.5 | 11 | 6,823 | sw. | 36 | sw. | 30 | 5 | 9 | 16 | 6.5 | 0.3 | 0.0 |
| Reading | 325 | 81 | 96 | 29.76 | 30.12 | ------ | 48.5 | ------ | 73 | 1 | 56 | 25 | 20 | 40 | 29 | 44 | 40 | 77 | 2.63 | −0.5 | 13 | 4,584 | s. | 30 | sw. | 30 | 5 | 8 | 17 | 6.9 | T. | 0.0 |
| Scranton | 805 | 111 | 119 | 29.23 | 30.10 | +.01 | 44.6 | +4.1 | 73 | 1 | 52 | 26 | 8 | 37 | 30 | 42 | 40 | 86 | 4.26 | +2.0 | 14 | 5,270 | s. | 44 | w. | 30 | 2 | 6 | 22 | 8.0 | T. | 0.0 |
| Atlantic City | 52 | 37 | 172 | 30.07 | 30.13 | +.03 | 50.8 | +5.2 | 73 | 12 | 57 | 28 | 20 | 44 | 26 | 46 | 43 | 80 | 2.20 | −1.0 | 9 | 12,959 | sw. | 59 | s. | 17 | 10 | 12 | 8 | 4.8 | T. | 0.0 |
| Cape May | 17 | 13 | 49 | ---- | ---- | ------ | 50.5 | +3.1 | 72 | 12 | 58 | 28 | 21 | 43 | 28 | 47 | 44 | 82 | 2.00 | ------ | 9 | ------ | nw. | ---- | ---- | ---- | 9 | 14 | 7 | ---- | 0.0 | 0.0 |
| Sandy Hook | 22 | 10 | 55 | 30.06 | 30.10 | ------ | 49.0 | ------ | 70 | 1 | 55 | 31 | 20 | 43 | 25 | 45 | 41 | 78 | 3.60 | ------ | 11 | 11,742 | sw. | 60 | s. | 17 | 5 | 12 | 13 | 6.5 | T. | 0.0 |
| Trenton | 190 | 152 | 183 | 29.91 | 30.02 | ------ | 49.3 | ------ | 75 | 2 | 58 | 31 | 20 | 41 | 28 | 44 | 40 | 77 | 3.57 | +0.1 | 12 | 7,737 | sw. | 39 | s. | 17 | 7 | 8 | 15 | 6.5 | 0.3 | 0.0 |
| Baltimore | 123 | 100 | 215 | 30.00 | 30.14 | +.03 | 51.6 | +5.3 | 74 | 29 | 60 | 32 | 20 | 43 | 24 | 46 | 42 | 74 | 2.22 | −0.7 | 8 | 7,282 | sw. | 48 | s. | 17 | 9 | 11 | 10 | 6.1 | T. | 0.0 |
| Washington | 112 | 62 | 85 | 30.01 | 30.14 | +.02 | 51.0 | +5.8 | 74 | 2 | 60 | 27 | 20 | 42 | 29 | 45 | 41 | 73 | 2.65 | −0.1 | 6 | 4,758 | s. | 45 | sw. | 17 | 7 | 13 | 10 | 5.8 | T. | 0.0 |
| Cape Henry | 18 | 8 | 54 | 30.14 | 30.16 | ------ | 55.6 | ------ | 80 | 12 | 63 | 31 | 21 | 48 | 26 | 50 | 45 | 75 | 4.40 | +1.7 | 8 | 10,143 | sw. | 57 | nw. | 4 | 10 | 14 | 6 | 5.0 | 0.0 | 0.0 |
| Lynchburg | 681 | 153 | 188 | 29.42 | 30.17 | +.04 | 51.6 | +4.4 | 77 | 11 | 62 | 26 | 20 | 41 | 35 | 45 | 41 | 75 | 1.91 | −0.9 | 8 | 5,533 | w. | 51 | sw. | 17 | 10 | 11 | 9 | 5.1 | 0.0 | 0.0 |
| Norfolk | 91 | 170 | 205 | 30.08 | 30.18 | +.07 | 55.6 | +4.2 | 77 | 12 | 64 | 31 | 7 | 47 | 30 | 48 | 44 | 73 | 2.36 | −0.4 | 8 | 10,220 | s. | 44 | nw. | 4 | 10 | 14 | 6 | 4.9 | 0.0 | 0.0 |
| Richmond | 144 | 11 | 52 | 30.02 | 30.17 | +.05 | 53.1 | +4.8 | 79 | 12 | 63 | 27 | 20 | 43 | 32 | 46 | 42 | 75 | 1.61 | −0.8 | 6 | 6,147 | sw. | 38 | sw. | 17 | 10 | 12 | 8 | 4.6 | 0.0 | 0.0 |
| Wytheville | 2,304 | 49 | 55 | 27.76 | 30.18 | +.05 | 46.4 | +3.4 | 72 | 2 | 56 | 20 | 20 | 37 | 35 | 41 | 38 | 77 | 3.12 | +0.1 | 9 | 4,891 | w. | 28 | sw. | 27 | 6 | 12 | 12 | 6.0 | T. | 0.0 |
| ***South Atlantic States*** | | | | | | | **58.3** | **+4.1** | | | | | | | | | | **78** | **1.63** | **−1.1** | | | | | | | | | | **5.0** | | |
| Asheville | 2,253 | 70 | 84 | 27.80 | 30.18 | +.04 | 49.8 | +4.7 | 74 | 2 | 59 | 24 | 20 | 41 | 32 | 44 | 40 | 75 | 2.76 | +0.5 | 9 | 6,237 | se. | 35 | n. | 17 | 10 | 5 | 15 | 5.9 | T. | 0.0 |
| Charlotte | 779 | 55 | 62 | 29.34 | 30.19 | +.06 | 55.0 | +4.4 | 79 | 12 | 64 | 29 | 7 | 46 | 26 | 48 | 43 | 70 | 1.30 | −1.6 | 4 | 3,765 | sw. | 23 | nw. | 4 | 9 | 9 | 12 | 5.6 | 0.0 | 0.0 |
| Hatteras | 11 | 11 | 50 | 30.16 | 30.17 | +.06 | 59.0 | +2.7 | 76 | 2 | 65 | 39 | 7 | 53 | 19 | 55 | 52 | 79 | 5.55 | +0.9 | 7 | 10,017 | sw. | 48 | nw. | 4 | 13 | 8 | 9 | 4.6 | 0.0 | 0.0 |
| Raleigh | 376 | 103 | 110 | 29.78 | 30.19 | +.06 | 54.7 | +3.7 | 78 | 12 | 64 | 29 | 20 | 45 | 27 | 49 | 45 | 78 | 1.55 | −0.8 | 5 | 5,524 | sw. | 30 | nw. | 4 | 13 | 6 | 11 | 5.1 | 0.0 | 0.0 |
| Wilmington | 78 | 81 | 91 | 30.12 | 30.20 | +.08 | 58.8 | +2.8 | 79 | 12 | 68 | 32 | 21 | 50 | 29 | 53 | 50 | 83 | 2.08 | −0.4 | 7 | 4,743 | sw. | 28 | s. | 17 | 13 | 7 | 10 | 4.7 | 0.0 | 0.0 |
| Charleston | 43 | 11 | 92 | 30.14 | 30.19 | +.07 | 61.6 | +3.5 | 79 | 25 | 69 | 39 | 19 | 54 | 22 | 56 | 53 | 81 | 0.46 | −2.4 | 6 | 6,418 | ne. | 33 | ne. | 13 | 14 | 10 | 6 | 4.2 | 0.0 | 0.0 |
| Columbia, S. C | 351 | 41 | 57 | 29.81 | 30.20 | +.08 | 58.4 | +4.4 | 82 | 12 | 68 | 30 | 21 | 48 | 33 | 50 | 45 | 70 | 0.51 | −1.7 | 5 | 4,692 | ne. | 34 | sw. | 17 | 12 | 10 | 8 | 5.0 | 0.0 | 0.0 |
| Due West | 711 | 10 | 55 | 29.44 | 30.22 | ------ | 56.0 | ------ | 78 | 2 | 66 | 29 | 21 | 46 | 33 | ---- | ---- | ---- | 1.54 | ------ | 6 | 6,055 | sw. | 33 | sw. | 17 | 8 | 10 | 12 | 5.8 | 0.0 | 0.0 |
| Greenville, S. C | 1,089 | 139 | 146 | 29.07 | 30.18 | ------ | 55.3 | +5.7 | 76 | 2 | 63 | 31 | 20 | 47 | 23 | 49 | 45 | 76 | 1.78 | ------ | 7 | 6,342 | ne. | 33 | w. | 4 | 11 | 6 | 13 | 5.5 | 0.0 | 0.0 |
| Augusta | 182 | 62 | 77 | 29.98 | 30.18 | +.05 | 59.9 | +5.4 | 82 | 12 | 71 | 30 | 21 | 49 | 39 | 53 | 50 | 78 | 0.82 | −2.1 | 4 | 3,617 | nw. | 27 | nw. | 4 | 7 | 14 | 9 | 5.4 | 0.0 | 0.0 |
| Savannah | 65 | 150 | 194 | 30.12 | 30.19 | +.07 | 62.8 | +4.3 | 81 | 12 | 72 | 36 | 21 | 54 | 27 | 56 | 54 | 83 | 0.40 | −2.0 | 3 | 8,074 | ne. | 34 | sw. | 17 | 14 | 10 | 6 | 4.3 | 0.0 | 0.0 |
| Jacksonville | 43 | 209 | 245 | 30.12 | 30.17 | +.07 | 65.7 | +3.5 | 83 | 9 | 74 | 39 | 19 | 58 | 26 | 59 | 56 | 80 | 0.83 | −1.4 | 7 | 8,311 | ne. | 36 | w. | 5 | 14 | 10 | 6 | 4.1 | 0.0 | 0.0 |
| ***Florida Peninsula*** | | | | | | | **72.4** | **+1.4** | | | | | | | | | | **76** | **0.52** | **−1.8** | | | | | | | | | | **3.8** | | |
| Key West | 22 | 10 | 64 | 30.04 | 30.06 | +.04 | 74.7 | +0.4 | 83 | 14 | 79 | 62 | 5 | 70 | 12 | 69 | 66 | 80 | 0.58 | −1.8 | 7 | 9,144 | ne. | 31 | nw. | 4 | 20 | 8 | 2 | 2.9 | 0.0 | 0.0 |
| Miami | 25 | 71 | 164 | 30.07 | 30.10 | ------ | 73.0 | +1.2 | 83 | 2 | 78 | 52 | 5 | 68 | 22 | 66 | 63 | 71 | 0.90 | −1.9 | 10 | 9,802 | e. | 30 | n. | 20 | 12 | 12 | 6 | 4.6 | 0.0 | 0.0 |
| Tampa | 35 | 70 | 87 | 30.10 | 30.14 | +.06 | 69.6 | +2.7 | 85 | 16 | 79 | 47 | 20 | 60 | 27 | 62 | 58 | 77 | 0.08 | −1.6 | 4 | 4,816 | e. | 22 | e. | 14 | 17 | 9 | 4 | 3.3 | 0.0 | 0.0 |
| Titusville | 44 | 5 | ---- | 30.09 | 30.14 | ------ | 68.4 | ------ | 84 | 3 | 78 | 45 | 5 | 58 | 37 | ---- | ---- | ---- | 0.87 | ------ | 8 | ------ | w. | ---- | ---- | ---- | 10 | 14 | 6 | 4.6 | 0.0 | 0.0 |
| ***East Gulf States*** | | | | | | | **61.6** | **+5.4** | | | | | | | | | | **77** | **3.37** | **−0.1** | | | | | | | | | | **4.9** | | |
| Atlanta | 1,173 | 190 | 216 | 28.94 | 30.19 | +.06 | 55.7 | +3.6 | 77 | 2 | 64 | 30 | 19 | 48 | 27 | 49 | 44 | 70 | 1.55 | −1.8 | 8 | 7,993 | nw. | 42 | nw. | 3 | 11 | 10 | 9 | 5.2 | 0.0 | 0.0 |
| Macon | 370 | 78 | 87 | 29.79 | 30.19 | +.06 | 59.3 | +5.1 | 80 | 12 | 70 | 30 | 21 | 48 | 38 | 52 | 47 | 74 | 0.98 | −2.1 | 7 | 3,979 | ne. | 29 | nw. | 3 | 12 | 7 | 11 | 5.1 | 0.0 | 0.0 |
| Thomasville | 273 | 49 | 58 | 29.88 | 30.17 | +.05 | 64.2 | +5.7 | 85 | 10 | 75 | 33 | 19 | 53 | 32 | 55 | 51 | 74 | 0.98 | −1.7 | 4 | 2,975 | e. | 17 | sw. | 5 | 10 | 12 | 8 | 4.8 | 0.0 | 0.0 |
| Apalachicola | 36 | 42 | 49 | 30.12 | 30.16 | ------ | 64.6 | ------ | 78 | 2 | 71 | 39 | 19 | 58 | 24 | 60 | 58 | 83 | 0.65 | ------ | 3 | 5,653 | ne. | 31 | e. | 13 | 18 | 7 | 5 | 3.3 | 0.0 | 0.0 |
| Pensacola | 56 | 149 | 185 | 30.10 | 30.16 | +.05 | 64.2 | +4.0 | 80 | 1 | 71 | 36 | 19 | 58 | 24 | 60 | 58 | 83 | 3.05 | −0.7 | 4 | 8,939 | e. | 35 | n. | 3 | 14 | 9 | 7 | 4.4 | 0.0 | 0.0 |
| Anniston | 741 | 9 | 57 | 29.40 | 30.21 | +.09 | 57.4 | +5.7 | 82 | 2 | 68 | 26 | 20 | 48 | 34 | ---- | ---- | ---- | 4.13 | +0.7 | 8 | 3,836 | s. | 21 | nw. | 2 | 10 | 11 | 9 | 5.2 | T. | 0.0 |
| Birmingham | 700 | 11 | 48 | 29.42 | 30.19 | +.07 | 59.2 | +5.3 | 81 | 2 | 69 | 30 | 20 | 50 | 29 | 52 | 48 | 74 | 4.84 | +1.4 | 10 | 5,301 | s. | 23 | s. | 16 | 10 | 10 | 10 | 5.6 | 0.0 | 0.0 |
| Mobile | 57 | 125 | 161 | 30.10 | 30.16 | +.05 | 64.4 | +5.8 | 82 | 1 | 73 | 32 | 20 | 56 | 27 | 58 | 56 | 82 | 3.64 | −0.1 | 6 | 6,939 | s. | 38 | n. | 30 | 12 | 8 | 10 | 5.0 | 0.0 | 0.0 |
| Montgomery | 223 | 100 | 112 | 29.94 | 30.19 | +.07 | 61.3 | +5.5 | 82 | 2 | 71 | 33 | 19 | 52 | 31 | 54 | 49 | 70 | 3.39 | +5.3 | 7 | 4,503 | se. | 28 | n. | 3 | 13 | 6 | 11 | 5.3 | 0.0 | 0.0 |
| Corinth | 469 | 6 | ---- | ---- | ---- | ------ | 57.1 | ------ | 82 | 1 | 67 | 29 | 20 | 47 | 32 | ---- | ---- | ---- | 5.66 | ------ | 7 | ------ | se. | ---- | ---- | ---- | 2 | 19 | 9 | ---- | 0.0 | 0.0 |
| Meridian | 375 | 87 | 95 | 29.76 | 30.16 | +.04 | 61.2 | +7.0 | 83 | 2 | 71 | 32 | 20 | 51 | 31 | 54 | 51 | 77 | 4.12 | 0.0 | 6 | 4,119 | s. | 23 | nw. | 2 | 10 | 7 | 13 | 5.7 | 0.0 | 0.0 |
| Vicksburg | 247 | 66 | 73 | 29.88 | 30.17 | +.05 | 62.8 | +6.2 | 82 | 10 | 72 | 34 | 18 | 53 | 29 | 55 | 51 | 74 | 3.09 | −1.1 | 8 | 5,017 | se. | 27 | nw. | 30 | 9 | 12 | 9 | 5.5 | 0.0 | 0.0 |
| New Orleans | 53 | 76 | 84 | 30.00 | 30.14 | +.04 | 67.3 | +5.7 | 84 | 2 | 76 | 41 | 18 | 59 | 24 | 61 | 59 | 82 | 2.25 | −1.5 | 8 | 4,258 | se. | 20 | ne. | 30 | 16 | 7 | 7 | 4.2 | 0.0 | 0.0 |
| ***West Gulf States*** | | | | | | | **65.2** | **+7.4** | | | | | | | | | | **75** | **1.83** | **−1.4** | | | | | | | | | | **4.9** | | |
| Shreveport | 249 | 77 | 93 | 29.85 | 30.12 | +.01 | 63.3 | +7.3 | 84 | 8 | 74 | 32 | 17 | 53 | 33 | 57 | 53 | 77 | 0.59 | −2.5 | 5 | 4,964 | se. | 30 | nw. | 30 | 9 | 15 | 6 | 5.1 | 0.0 | 0.0 |
| Bentonville | 1,308 | 11 | 44 | ---- | ---- | ------ | 51.4 | +4.7 | 78 | 1 | 62 | 23 | 17 | 41 | 43 | ---- | ---- | ---- | 5.46 | ------ | 11 | 6,089 | s. | 30 | s. | 21 | 6 | 12 | 12 | ---- | T. | 0.0 |
| Fort Smith | 457 | 79 | 94 | 29.59 | 30.08 | −.03 | 55.8 | +4.8 | 80 | 1 | 66 | 29 | 17 | 46 | 40 | 50 | 46 | 74 | 2.74 | −0.5 | 5 | 7,515 | e. | 49 | w. | 15 | 4 | 7 | 19 | 7.2 | 0.0 | 0.0 |
| Little Rock | 357 | 136 | 144 | 29.74 | 30.12 | .00 | 55.3 | +4.2 | 81 | 1 | 65 | 31 | 17 | 47 | 38 | 51 | 48 | 77 | 3.18 | +3.6 | 9 | 7,519 | s. | 43 | nw. | 30 | 5 | 9 | 16 | 6.7 | 0.0 | 0.0 |
| Austin | 605 | 136 | 148 | 29.44 | 30.07 | ------ | 68.2 | +9.7 | 86 | 8 | 78 | 36 | 17 | 58 | 32 | ---- | ---- | ---- | 0.02 | −2.5 | 1 | 6,625 | s. | 34 | n. | 30 | 3 | 17 | 5 | 5.0 | 0.0 | 0.0 |
| Brownsville | 57 | 53 | 61 | 29.97 | 30.03 | ------ | 73.8 | +6.6 | 89 | 30 | 82 | 43 | 17 | 66 | 30 | 66 | 63 | 79 | 1.32 | ------ | 5 | 5,253 | s. | 26 | nw. | 16 | 12 | 17 | 1 | 3.8 | 0.0 | 0.0 |
| Corpus Christi | 20 | 11 | 78 | 30.04 | 30.06 | −.01 | 72.8 | +8.5 | 90 | 2 | 79 | 48 | 16 | 66 | 29 | 67 | 64 | 81 | 3.11 | +0.7 | 8 | 8,920 | se. | 35 | n. | 3 | 16 | 6 | 8 | 4.4 | 0.0 | 0.0 |
| Dallas | 512 | 220 | 227 | 29.53 | 30.07 | ------ | 63.2 | ------ | 85 | 8 | 74 | 32 | 17 | 52 | 34 | ---- | ---- | ---- | 0.35 | ------ | 1 | 11,172 | s. | 50 | nw. | 30 | 13 | 12 | 5 | 4.2 | 0.0 | 0.0 |
| Fort Worth | 670 | 106 | 114 | 29.34 | 30.08 | −.04 | 63.1 | +7.6 | 88 | 8 | 74 | 35 | 17 | 52 | 34 | 54 | 48 | 66 | 0.58 | −2.0 | 1 | 8,254 | s. | 32 | s. | 21 | 10 | 13 | 7 | 4.9 | 0.0 | 0.0 |
| Galveston | 54 | 106 | 114 | 30.06 | 30.12 | +.03 | 71.3 | +8.0 | 81 | 2 | 76 | 44 | 17 | 66 | 24 | 66 | 63 | 81 | 1.43 | −2.6 | 4 | 8,567 | s. | 32 | n. | 30 | 17 | 10 | 3 | 3.2 | 0.0 | 0.0 |
| Groesbeck | 461 | 11 | 56 | 29.59 | 30.07 | ------ | 65.8 | ------ | 85 | 9 | 76 | 32 | 17 | 56 | 33 | ---- | ---- | ---- | 0.75 | ------ | 2 | 8,567 | s. | 37 | nw. | 30 | 7 | 17 | 6 | 5.2 | 0.0 | 0.0 |
| Houston | 138 | 292 | 314 | 29.95 | 30.10 | ------ | 69.3 | +8.3 | 86 | 8 | 78 | 38 | 17 | 60 | 32 | ---- | ---- | ---- | 2.12 | −1.6 | 6 | 10,537 | se. | 39 | nw. | 30 | 7 | 14 | 9 | 5.6 | 0.0 | 0.0 |
| Palestine | 510 | 64 | 72 | 29.56 | 30.10 | −.01 | 64.9 | +7.7 | 84 | 11 | 74 | 32 | 17 | 56 | 30 | 58 | 54 | 74 | 1.33 | −2.3 | 2 | 6,460 | s. | 32 | nw. | 30 | 6 | 18 | 6 | 5.5 | 0.0 | 0.0 |
| Port Arthur | 34 | 58 | 66 | 30.07 | 30.11 | ------ | 69.4 | ------ | 84 | 2 | 77 | 36 | 17 | 62 | 27 | ---- | ---- | ---- | 1.56 | ------ | 6 | 5,778 | s. | 29 | n. | 30 | 16 | 8 | 6 | 3.9 | 0.0 | 0.0 |
| San Antonio | 693 | 119 | 132 | 29.33 | 30.08 | −.02 | 69.8 | +0.5 | 87 | 8 | 80 | 39 | 17 | 59 | 32 | 60 | 56 | 70 | 0.03 | −1.8 | 3 | 5,863 | s. | 30 | nw. | 30 | 10 | 16 | 4 | 4.4 | 0.0 | 0.0 |
| Taylor | 583 | 54 | 63 | 30.49 | 30.10 | +.02 | 67.1 | +0.4 | 85 | 8 | 78 | 36 | 17 | 53 | 32 | ---- | ---- | ---- | 0.04 | −2.6 | 1 | 6,717 | s. | 31 | nw. | 30 | 9 | 16 | 5 | 4.4 | 0.0 | 0.0 |

TABLE 1.—*Climatological data for Weather Bureau stations, November, 1927*—Continued

| District and station | Elevation of instruments: Barometer above sea level | Elevation of instruments: Thermometer above ground | Elevation of instruments: Anemometer above ground | Pressure: Station reduced to mean of 24 hours | Pressure: Sea level, reduced to mean of 24 hours | Pressure: Departure from normal | Temperature of the air: Mean max. + mean min. ÷2 | Temperature of the air: Departure from normal | Temperature of the air: Maximum | Temperature of the air: Date | Temperature of the air: Mean maximum | Temperature of the air: Minimum | Temperature of the air: Date | Temperature of the air: Mean minimum | Temperature of the air: Greatest daily range | Mean wet thermometer | Mean temperature of the dew-point | Mean relative humidity | Precipitation: Total | Precipitation: Departure from normal | Precipitation: Days with 0.01, or more | Wind: Total movement | Wind: Prevailing direction | Wind: Maximum velocity: Miles per hour | Wind: Maximum velocity: Direction | Wind: Maximum velocity: Date | Clear days | Partly cloudy days | Cloudy days | Average cloudiness, tenths | Total snowfall | Snow, sleet, and ice on ground at end of month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ft. | Ft. | Ft. | In. | In. | In. | °F. | °F. | °F. | | °F. | °F. | | °F. | °F. | °F. | °F. | % | In. | In. | | Miles | | | | | | | | 0–10 | In. | In. |
| ***Ohio Valley and Tennessee*** | | | | | | | **50.0** | **+4.8** | | | | | | | | | | **76** | **5.01** | **+1.6** | | | | | | | | | | **7.2** | | |
| Chattanooga | 762 | 189 | 213 | 29.36 | 30.19 | +.05 | 54.9 | +4.5 | 78 | 1 | 63 | 31 | 19 | 46 | 28 | 46 | 44 | 70 | 5.77 | +2.2 | 10 | 5,209 | se. | 27 | nw. | 3 | 8 | 7 | 15 | 6.4 | 0.0 | 0.0 |
| Knoxville | 995 | 102 | 111 | 29.12 | 30.19 | +.06 | 52.8 | +4.9 | 77 | 1 | 62 | 26 | 20 | 44 | 32 | 47 | 44 | 77 | 2.52 | −1.1 | 10 | 4,201 | sw. | 30 | s. | 30 | 10 | 12 | 8 | 5.3 | 0.0 | 0.0 |
| Memphis | 399 | 76 | 97 | 29.71 | 30.14 | +.02 | 56.2 | +4.5 | 79 | 1 | 65 | 29 | 18 | 49 | 36 | 51 | 47 | 77 | 6.11 | +1.5 | 7 | 5,397 | sw. | 44 | nw. | 30 | 2 | 11 | 17 | 6.9 | 0.0 | 0.0 |
| Nashville | 546 | 168 | 191 | 29.58 | 30.18 | +.06 | 55.6 | +4.6 | 78 | 11 | 62 | 27 | 20 | 46 | 32 | 48 | 43 | 72 | 4.42 | +0.6 | 11 | 8,174 | s. | 48 | nw. | 30 | 6 | 11 | 13 | 6.5 | T. | 0.0 |
| Lexington | 989 | 193 | 230 | 29.07 | 30.15 | +.03 | 49.6 | +4.8 | 74 | 11 | 58 | 23 | 19 | 41 | 37 | | | | 4.88 | +1.4 | 11 | 11,537 | sw. | 52 | nw. | 30 | 9 | 6 | 15 | 6.5 | 0.3 | 0.0 |
| Louisville | 525 | 188 | 234 | 29.55 | 30.14 | +.02 | 50.4 | +3.7 | 77 | 11 | 58 | 26 | 19 | 42 | 34 | 45 | 42 | 76 | 3.65 | −0.5 | 13 | 10,028 | s. | 52 | nw. | 30 | 5 | 10 | 15 | 6.8 | T. | 0.0 |
| Evansville | 431 | 76 | 116 | 29.67 | 30.15 | +.03 | 50.1 | +3.5 | 77 | 11 | 58 | 26 | 6 | 42 | 36 | 45 | 41 | 75 | 3.60 | −0.5 | 11 | 8,472 | s. | 41 | nw. | 30 | 3 | 13 | 14 | 7.2 | T. | 0.0 |
| Indianapolis | 822 | 194 | 220 | 29.19 | 30.10 | .00 | 46.6 | +4.3 | 76 | 11 | 55 | 23 | 19 | 38 | 41 | 42 | 37 | 74 | 4.69 | +1.2 | 15 | 10,426 | s. | 42 | nw. | 11 | 3 | 10 | 17 | 7.8 | 0.9 | 0.3 |
| Royal Center | 736 | 11 | 55 | 29.26 | 30.08 | ------ | 43.8 | ------ | 74 | 1 | 52 | 19 | 19 | 35 | 32 | | | | 6.85 | ------ | 16 | 9,275 | s. | 43 | w. | 11 | 2 | 7 | 21 | 7.8 | 2.4 | 1.8 |
| Terre Haute | 575 | 96 | 129 | 29.46 | 30.09 | ------ | 47.2 | ------ | 77 | 1 | 56 | 25 | 6 | 39 | 39 | 43 | 40 | 80 | 4.84 | ------ | 13 | 8,777 | s. | 41 | nw. | 11 | 4 | 8 | 18 | 7.4 | 0.9 | 0.5 |
| Cincinnati | 627 | 11 | 51 | 29.44 | 30.13 | +.01 | 48.8 | +0.3 | 76 | 11 | 57 | 23 | 19 | 41 | 34 | 43 | 40 | 78 | 6.46 | +3.2 | 17 | 6,653 | sw. | 38 | w. | 28 | 6 | 6 | 18 | 7.0 | 0.6 | 0.0 |
| Columbus | 822 | 179 | 222 | 29.22 | 30.11 | .00 | 47.1 | +5.2 | 74 | 11 | 55 | 25 | 19 | 39 | 34 | 43 | 39 | 76 | 6.19 | +3.1 | 16 | 8,973 | s. | 55 | nw. | 30 | 3 | 7 | 20 | 7.6 | 2.4 | T. |
| Dayton | 899 | 137 | 173 | 29.14 | 30.11 | ------ | 47.1 | +5.1 | 74 | 11 | 55 | 22 | 19 | 40 | 34 | 43 | 39 | 77 | 6.80 | +3.6 | 17 | 8,665 | sw. | 46 | sw. | 28 | 2 | 9 | 19 | 7.7 | 1.3 | T. |
| Elkins | 1,947 | 59 | 67 | 28.07 | 30.16 | +.04 | 46.6 | +6.3 | 73 | 1 | 56 | 20 | 7 | 37 | 38 | 42 | 39 | 80 | 4.47 | +1.6 | 18 | 4,700 | w. | 35 | w. | 17 | 1 | 6 | 23 | 8.4 | 8.7 | 0.0 |
| Parkersburg | 637 | 77 | 82 | 29.48 | 30.14 | +.02 | 49.5 | +5.7 | 77 | 1 | 58 | 26 | 20 | 41 | 36 | 44 | 39 | 73 | 5.59 | +2.8 | 18 | 5,011 | se. | 42 | nw. | 30 | 2 | 5 | 23 | 8.4 | 0.2 | 0.0 |
| Pittsburgh | 842 | 353 | 410 | 29.18 | 30.10 | .00 | 47.2 | +4.0 | 73 | 15 | 54 | 24 | 19 | 40 | 35 | 43 | 39 | 75 | 5.18 | +2.0 | 17 | 9,860 | sw. | 54 | nw. | 30 | 3 | 5 | 22 | 8.2 | T. | 0.0 |
| ***Lower Lake Region*** | | | | | | | **43.8** | **+4.4** | | | | | | | | | | **79** | **7.31** | **+4.4** | | | | | | | | | | **8.3** | | |
| Buffalo | 767 | 247 | 280 | 29.19 | 30.04 | −.01 | 42.8 | +3.4 | 70 | 18 | 50 | 22 | 19 | 36 | 36 | 40 | 37 | 82 | 6.71 | +3.7 | 19 | 13,963 | sw. | 70 | sw. | 29 | 1 | 9 | 20 | 8.1 | 2.1 | T. |
| Canton | 448 | 10 | 61 | 29.53 | 30.02 | ------ | 38.2 | +4.3 | 72 | 2 | 46 | 14 | 9 | 30 | 34 | | | | 9.25 | +5.8 | 22 | 8,085 | sw. | 49 | sw. | 29 | 1 | 9 | 20 | 8.2 | 13.2 | 0.0 |
| Oswego | 335 | 76 | 91 | ------ | 30.04 | −.01 | 42.2 | +3.3 | 72 | 1 | 50 | 22 | 20 | 35 | 38 | | | 82 | 8.97 | +5.6 | 22 | 9,040 | s. | 39 | nw. | 30 | 0 | 6 | 24 | ---- | 2.0 | 0.0 |
| Rochester | 523 | 86 | 102 | 29.47 | 30.05 | .00 | 43.4 | +4.7 | 74 | 1 | 51 | 24 | 20 | 36 | 35 | 40 | 36 | 77 | 7.12 | +4.4 | 23 | 6,253 | sw. | 37 | sw. | 12 | 1 | 2 | 27 | 9.0 | 0.9 | 0.0 |
| Syracuse | 597 | 97 | 113 | 29.41 | 30.06 | .00 | 42.9 | +4.2 | 72 | 1 | 50 | 22 | 20 | 36 | 30 | | | | 7.78 | +5.1 | 19 | 9,672 | s. | 47 | nw. | 12 | 1 | 5 | 24 | 8.5 | 8.9 | 0.0 |
| Erie | 714 | 130 | 166 | 29.27 | 30.05 | −.01 | 45.8 | +4.4 | 73 | 1 | 53 | 25 | 19 | 36 | 36 | 42 | 38 | 75 | 8.78 | +5.2 | 18 | 11,955 | s. | 50 | sw. | 29 | 2 | 7 | 21 | 8.0 | 16.6 | 0.0 |
| Cleveland | 762 | 190 | 201 | 29.23 | 30.06 | −.01 | 46.6 | +5.7 | 72 | 1 | 54 | 25 | 19 | 39 | 34 | 42 | 38 | 75 | 7.19 | +4.4 | 17 | 11,711 | s. | 55 | n. | 30 | 1 | 5 | 24 | 8.6 | 0.7 | T. |
| Sandusky | 629 | 5 | 67 | 29.37 | 30.07 | −.01 | 46.4 | +5.3 | 75 | 11 | 54 | 24 | 19 | 38 | 33 | | | | 6.43 | +3.7 | 17 | 8,949 | sw. | 40 | sw. | 11 | 1 | 9 | 20 | 8.1 | 2.4 | 1.5 |
| Toledo | 628 | 208 | 243 | 29.38 | 30.07 | .00 | 45.2 | +4.8 | 73 | 11 | 53 | 21 | 19 | 38 | 34 | 41 | 37 | 78 | 5.68 | +2.9 | 13 | 11,137 | sw. | 60 | w. | 11 | 3 | 7 | 20 | 8.0 | 1.5 | 1.0 |
| Fort Wayne | 856 | 113 | 124 | 29.12 | 30.06 | ------ | 44.6 | +4.0 | 74 | 11 | 53 | 23 | 19 | 37 | 31 | 41 | 38 | 78 | 5.36 | ------ | 18 | 8,199 | sw. | 41 | sw. | 11 | 2 | 7 | 21 | 8.2 | 5.8 | 4.0 |
| Detroit | 730 | 218 | 268 | 29.25 | 30.06 | .00 | 43.4 | +4.1 | 70 | 1 | 50 | 16 | 19 | 37 | 31 | 40 | 37 | 82 | 5.29 | +2.7 | 17 | 8,140 | sw. | 40 | w. | 11 | 1 | 8 | 21 | 8.3 | 3.8 | 3.8 |
| ***Upper Lake Region*** | | | | | | | **36.2** | **+0.9** | | | | | | | | | | **82** | **3.53** | **+1.1** | | | | | | | | | | **8.3** | | |
| Alpena | 609 | 13 | 92 | 29.33 | 30.01 | .00 | 36.8 | +2.4 | 69 | 1 | 43 | 19 | 7 | 30 | 32 | 34 | 31 | 83 | 3.72 | +1.2 | 17 | 9,181 | nw. | 42 | nw. | 30 | 2 | 6 | 22 | 8.2 | 4.5 | 0.0 |
| Escanaba | 612 | 54 | 60 | 29.34 | 30.02 | −.01 | 32.6 | −0.5 | 55 | 1 | 38 | 10 | 30 | 27 | 28 | 30 | 28 | 82 | 2.19 | −0.1 | 11 | 7,632 | nw. | 32 | nw. | 5 | 4 | 7 | 19 | 7.4 | 5.9 | T. |
| Grand Haven | 632 | 54 | 89 | 29.33 | 30.02 | −.02 | 41.4 | +2.9 | 70 | 1 | 47 | 24 | 18 | 35 | 27 | 39 | 35 | 81 | 3.97 | +1.4 | 14 | 10,015 | s. | 55 | w. | 11 | 1 | 4 | 25 | 8.7 | 0.6 | 0.0 |
| Grand Rapids | 707 | 70 | 87 | 29.25 | 30.04 | −.01 | 41.8 | +3.4 | 71 | 1 | 48 | 23 | 18 | 35 | 29 | 38 | 34 | 77 | 4.55 | +2.0 | 15 | 4,831 | nw. | 28 | nw. | 11 | 0 | 2 | 28 | 9.3 | 0.1 | 0.0 |
| Houghton | 668 | 64 | 99 | 29.29 | 30.04 | +.02 | 29.8 | −2.2 | 54 | 1 | 34 | 11 | 30 | 25 | 20 | | | | 3.73 | +0.9 | 20 | 7,101 | w. | 54 | w. | 12 | 2 | 4 | 24 | 8.6 | 25.7 | 2.0 |
| Lansing | 878 | 11 | 62 | 29.06 | 30.04 | ------ | 40.5 | +3.0 | 71 | 1 | 48 | 15 | 19 | 33 | 29 | 38 | 37 | 89 | 4.70 | +2.3 | 16 | 5,301 | sw. | 26 | sw. | 11 | 2 | 9 | 19 | 8.0 | 2.3 | T. |
| Ludington | 637 | 60 | 66 | 29.30 | 30.01 | ------ | 39.8 | ------ | 68 | 1 | 45 | 20 | 18 | 34 | 25 | 37 | 35 | 87 | 5.39 | ------ | 18 | 9,110 | s. | 46 | sw. | 11 | 2 | 6 | 22 | 8.3 | 12.5 | 0.0 |
| Marquette | 734 | 77 | 111 | 29.20 | 30.00 | −.02 | 31.9 | −1.4 | 59 | 1 | 37 | 12 | 19 | 27 | 21 | 29 | 26 | 83 | 3.59 | +0.8 | 20 | 7,062 | w. | 29 | w. | 12 | 4 | 2 | 24 | 8.4 | 25.8 | T. |
| Port Huron | 638 | 70 | 120 | 29.33 | 30.03 | −.02 | 41.8 | +4.2 | 68 | 1 | 49 | 18 | 19 | 34 | 35 | 38 | 35 | 81 | 3.67 | +1.0 | 18 | 9,852 | nw. | 43 | w. | 11 | 4 | 7 | 19 | 7.7 | 4.9 | 4.0 |
| Sault Sainte Marie | 614 | 11 | 52 | 29.30 | 30.02 | +.01 | 31.4 | −0.6 | 62 | 1 | 37 | 7 | 18 | 26 | 23 | 29 | 27 | 85 | 3.32 | +0.9 | 20 | 7,192 | se. | 44 | nw. | 11 | 2 | 2 | 26 | 8.9 | 11.3 | 2.8 |
| Chicago | 673 | 7 | 131 | 29.32 | 30.05 | −.02 | 43.2 | +3.1 | 75 | 1 | 50 | 23 | 18 | 36 | 31 | 39 | 35 | 76 | 4.66 | +2.2 | 15 | 9,157 | nw. | 40 | sw. | 11 | 2 | 6 | 22 | 8.2 | 4.9 | 0.0 |
| Green Bay | 617 | 109 | 141 | 29.34 | 30.02 | −.02 | 34.8 | +0.8 | 67 | 1 | 41 | 14 | 19 | 29 | 25 | 32 | 28 | 79 | 2.32 | +0.4 | 13 | 8,167 | s. | 38 | ne. | 15 | 4 | 4 | 22 | 7.9 | 1.4 | 0.0 |
| Milwaukee | 681 | 125 | 221 | 29.28 | 30.03 | −.02 | 40.0 | +2.7 | 73 | 1 | 47 | 21 | 18 | 33 | 27 | 36 | 32 | 76 | 2.96 | +1.0 | 13 | 10,556 | nw. | 43 | sw. | 11 | 3 | 6 | 21 | 8.0 | 0.1 | 0.0 |
| Duluth | 1,133 | 5 | 47 | 28.78 | 30.05 | +.01 | 24.2 | −5.8 | 48 | 2 | 31 | −8 | 30 | 18 | 29 | 23 | 20 | 86 | 2.04 | +0.5 | 17 | 9,592 | nw. | 49 | nw. | 11 | 5 | 5 | 20 | 7.9 | 17.3 | 4.5 |
| ***North Dakota*** | | | | | | | **20.8** | **−5.5** | | | | | | | | | | **80** | **0.80** | **0.0** | | | | | | | | | | **7.1** | | |
| Moorhead | 940 | 50 | 58 | 29.03 | 30.03 | +.01 | 23.2 | −3.9 | 53 | 3 | 31 | −8 | 30 | 16 | 24 | 21 | 17 | 80 | 0.72 | −0.3 | 8 | 6,305 | n. | 31 | nw. | 11 | 3 | 9 | 18 | 7.5 | 7.0 | 2.2 |
| Bismarck | 1,674 | 8 | 57 | 28.23 | 30.09 | +.02 | 22.6 | −5.9 | 52 | 3 | 31 | −3 | 29 | 14 | 39 | 20 | 16 | 77 | 0.80 | +0.1 | 9 | 6,418 | nw. | 36 | nw. | 10 | 4 | 9 | 17 | 6.8 | 10.0 | 3.7 |
| Devils Lake | 1,478 | 11 | 44 | 28.44 | 30.09 | +.03 | 17.6 | −5.0 | 50 | 3 | 25 | −10 | 17 | 10 | 32 | 16 | 14 | 86 | 0.63 | −0.1 | 9 | 7,354 | nw. | 33 | nw. | 11 | 7 | 4 | 19 | 7.0 | 3.3 | 1.1 |
| Ellendale | 1,457 | 10 | 56 | 28.45 | 30.06 | ------ | 23.4 | ------ | 55 | 3 | 32 | −1 | 30 | 15 | 35 | | | | 0.31 | ------ | 9 | 9,377 | nw. | 49 | n. | 29 | 3 | 11 | 16 | 7.3 | 4.2 | 0.4 |
| Grand Forks | 833 | 12 | 67 | ------ | ------ | ------ | 21.0 | ------ | 52 | 3 | 28 | −7 | 30 | 14 | 33 | | | | 0.47 | ------ | 8 | ------ | nw. | 35 | nw. | 10 | 4 | 8 | 18 | ---- | 7.5 | ---- |
| Williston | 1,878 | 41 | 48 | 28.02 | 30.08 | +.02 | 20.0 | −7.2 | 50 | 2 | 27 | −8 | 17 | 13 | 33 | 18 | 14 | 77 | 1.04 | +0.4 | 13 | 5,885 | e. | 36 | nw. | 2 | 5 | 10 | 15 | 6.9 | 7.6 | 2.5 |
| ***Upper Mississippi Valley*** | | | | | | | **40.3** | **+1.9** | | | | | | | | | | **79** | **2.67** | **+0.7** | | | | | | | | | | **7.6** | | |
| Minneapolis | 918 | 102 | 208 | 29.04 | 30.05 | ------ | 20.0 | −2.4 | 50 | 11 | 36 | 4 | 30 | 24 | 26 | | | | 1.50 | +0.3 | 9 | 8,603 | nw. | 36 | nw. | 11 | 7 | 5 | 18 | 7.3 | 5.3 | T. |
| St. Paul | 837 | 236 | 261 | 29.09 | 30.03 | −.03 | 29.2 | −3.3 | 49 | 11 | 36 | 4 | 30 | 23 | 28 | | | | 1.47 | +0.2 | 9 | 8,867 | nw. | 40 | nw. | 11 | 4 | 7 | 19 | 7.6 | 6.2 | T. |
| La Crosse | 714 | 11 | 48 | 29.24 | 30.04 | −.03 | 35.2 | 0.0 | 67 | 11 | 42 | 14 | 18 | 26 | 39 | 32 | 29 | 83 | 2.07 | +0.6 | 13 | 3,874 | s. | 20 | nw. | 11 | 4 | 6 | 20 | 7.8 | 2.4 | 0.0 |
| Madison | 974 | 70 | 78 | 28.97 | 30.05 | −.01 | 37.4 | +2.2 | 69 | 11 | 44 | 18 | 18 | 31 | 39 | 34 | 31 | 81 | 2.42 | +0.6 | 10 | 7,259 | s. | 31 | n. | 20 | 2 | 5 | 23 | 8.2 | 0.8 | 0.0 |
| Wausau | 1,247 | 4 | ---- | 28.66 | 30.03 | ------ | 31.1 | ------ | 59 | 1 | 37 | 7 | 30 | 25 | 30 | | | | 2.16 | ------ | 12 | ------ | se. | ---- | ---- | ---- | 2 | 2 | 26 | 8.5 | 4.5 | 0.0 |
| Charles City | 1,015 | 10 | 49 | 28.95 | 30.05 | −.03 | 34.2 | +1.2 | 63 | 11 | 42 | 12 | 17 | 26 | 38 | 31 | 28 | 82 | 0.95 | −0.4 | 9 | 5,278 | nw. | 25 | nw. | 11 | 5 | 7 | 18 | 7.2 | 3.6 | 0.0 |
| Davenport | 606 | 71 | 79 | 29.38 | 30.05 | −.03 | 41.8 | +2.8 | 72 | 11 | 50 | 21 | 18 | 34 | 40 | 38 | 35 | 79 | 2.38 | +0.6 | 11 | 5,559 | s. | 34 | w. | 11 | 4 | 6 | 20 | 7.9 | T. | 0.0 |
| Des Moines | 861 | 84 | 97 | 29.12 | 30.04 | −.04 | 39.2 | +0.8 | 77 | 10 | 48 | 12 | 18 | 30 | 40 | 36 | 31 | 78 | 0.44 | −1.0 | 5 | 5,629 | sw. | 30 | sw. | 10 | 3 | 5 | 22 | 8.2 | T. | 0.0 |
| Dubuque | 700 | 81 | 96 | 29.28 | 30.04 | −.06 | 39.5 | +2.5 | 71 | 11 | 47 | 20 | 18 | 32 | 42 | 36 | 32 | 78 | 1.01 | −0.8 | 8 | 5,139 | s. | 30 | nw. | 11 | 4 | 3 | 23 | 8.1 | 1.4 | 0.0 |
| Keokuk | 614 | 64 | 78 | 29.39 | 30.06 | −.01 | 43.8 | +2.7 | 78 | 1 | 53 | 19 | 18 | 35 | 39 | 39 | 35 | 74 | 3.61 | +1.8 | 11 | 6,509 | nw. | 35 | nw. | 1 | 3 | 7 | 20 | 7.9 | T. | 0.0 |
| Cairo | 358 | 87 | 93 | 29.75 | 30.14 | +.02 | 51.9 | +4.6 | 79 | 1 | 60 | 29 | 17 | 43 | 37 | 47 | 43 | 76 | 4.52 | +0.5 | 10 | 8,714 | s. | 39 | n. | 30 | 3 | 7 | 20 | 7.6 | T. | 0.0 |
| Peoria | 609 | 11 | 45 | 29.40 | 30.08 | −.01 | 43.3 | +5.8 | 77 | 1 | 52 | 19 | 6 | 35 | 39 | 40 | 37 | 81 | 3.33 | +0.7 | 13 | 6,153 | s. | 36 | w. | 11 | 6 | 6 | 18 | 7.2 | 0.0 | 0.0 |
| Springfield, Ill | 636 | 10 | 91 | 29.39 | 30.08 | −.02 | 45.2 | +3.0 | 77 | 1 | 54 | 24 | 6 | 37 | 37 | 41 | 38 | 79 | 4.96 | +2.3 | 11 | 7,460 | s. | 28 | sw. | 11 | 2 | 9 | 19 | 7.6 | 3.3 | 2.9 |
| Hannibal | 534 | 74 | 109 | 29.48 | 30.06 | −.03 | 45.4 | +3.3 | 81 | 1 | 55 | 20 | 30 | 36 | 41 | | | | 3.15 | +1.2 | 13 | 7,833 | sw. | 28 | sw. | 28 | 5 | 7 | 18 | 7.2 | 4.5 | 3.5 |
| St. Louis | 568 | 205 | 303 | 29.48 | 30.09 | −.01 | 48.0 | +2.9 | 80 | 1 | 56 | 27 | 18 | 40 | 37 | 44 | 40 | 78 | 5.56 | +2.7 | 11 | 11,552 | sw. | 53 | sw. | 1 | 8 | 7 | 15 | 6.5 | 0.8 | 0.7 |
| ***Missouri Valley*** | | | | | | | **39.1** | **+0.1** | | | | | | | | | | **74** | **1.34** | **+0.1** | | | | | | | | | | **7.1** | | |
| Columbia, Mo | 784 | 11 | 84 | 29.22 | 30.07 | −.02 | 46.0 | +2.7 | 82 | 1 | 56 | 17 | 30 | 36 | 43 | | | | 4.29 | +2.0 | 9 | 7,069 | s. | 34 | w. | 11 | 5 | 7 | 18 | 7.2 | 4.8 | 3.7 |
| Kansas City | 963 | 161 | 181 | 29.01 | 30.07 | −.02 | 45.2 | +1.5 | 76 | 10 | 54 | 21 | 18 | 36 | 37 | 40 | 35 | 73 | 1.13 | −0.7 | 6 | 8,390 | s. | 39 | nw. | 11 | 4 | 9 | 17 | 7.3 | 1.0 | 0.2 |
| St. Joseph | 967 | 11 | 49 | 29.00 | 30.06 | ------ | 43.3 | ------ | 82 | 10 | 52 | 20 | 18 | 34 | 40 | 38 | 34 | 73 | 0.58 | ------ | 5 | 8,359 | nw. | 39 | nw. | 11 | 5 | 8 | 17 | 6.8 | 0.5 | 0.1 |
| Springfield, Mo | 1,334 | 98 | 104 | 28.63 | 30.05 | −.05 | 47.9 | +2.2 | 79 | 1 | 58 | 22 | 18 | 38 | 39 | 43 | 39 | 78 | 5.44 | +2.6 | 9 | 9,208 | s. | 39 | w. | 1 | 5 | 10 | 15 | 6.9 | 0.2 | T. |
| Iola | 984 | 11 | 30 | 28.99 | 30.05 | −.04 | 46.4 | +2.3 | 78 | 1 | 57 | 21 | 30 | 36 | 38 | | | | 1.88 | +0.4 | 6 | 6,018 | s. | 33 | n. | 30 | 3 | 9 | 18 | 7.4 | 0.4 | 0.0 |
| Topeka | 987 | 92 | 107 | ------ | ------ | ------ | 44.6 | +1.8 | 82 | 10 | 54 | 22 | 16 | 35 | 38 | | | | 0.72 | −0.5 | 5 | 7,422 | sw. | 36 | sw. | 10 | 8 | 5 | 17 | 6.7 | 0.8 | T. |
| Lincoln | 1,189 | 11 | 84 | 28.76 | 30.06 | −.02 | 39.9 | +0.8 | 79 | 10 | 50 | 16 | 16 | 30 | 44 | 34 | 28 | 68 | 0.04 | −0.3 | 4 | 7,354 | s. | 42 | nw. | 11 | 5 | 5 | 20 | 7.3 | 0.1 | 0.0 |
| Omaha | 1,105 | 115 | 122 | 28.85 | 30.06 | −.02 | 39.2 | +0.7 | 78 | 10 | 48 | 14 | 18 | 30 | 41 | 34 | 30 | 73 | 0.06 | −1.0 | 4 | 6,194 | nw. | 37 | nw. | 11 | 7 | 8 | 15 | 6.6 | 0.2 | 0.0 |
| Valentine | 2,598 | 47 | 54 | 27.27 | 30.06 | −.02 | 34.4 | −0.2 | 76 | 10 | 45 | 11 | 12 | 34 | 45 | 29 | 24 | 73 | 0.59 | −0.1 | 6 | 6,158 | w. | 32 | nw. | 11 | 4 | 9 | 17 | 7.1 | 9.1 | 0.0 |
| Sioux City | 1,135 | 94 | 104 | 28.82 | 30.07 | −.01 | 35.0 | −0.2 | 62 | 10 | 43 | 9 | 18 | 27 | 27 | 31 | 27 | 75 | 0.43 | −0.6 | 5 | 8,328 | nw. | 46 | nw. | 11 | 3 | 12 | 15 | 7.2 | 1.8 | 0.0 |
| Huron | 1,306 | 58 | 74 | 28.64 | 30.09 | +.01 | 27.8 | −3.7 | 58 | 10 | 37 | 0 | 17 | 19 | 31 | 24 | 21 | 79 | 0.49 | −0.1 | 5 | 6,709 | nw. | 40 | nw. | 29 | 6 | 9 | 15 | 6.5 | 4.9 | T. |
| Pierre | 1,572 | 70 | 75 | ------ | 30.09 | +.01 | 29.2 | −4.4 | 59 | 2 | 37 | 9 | 16 | 21 | 34 | ---- | ---- | 80 | 0.37 | −0.1 | 4 | 6,067 | nw. | 36 | nw. | 11 | 4 | 11 | 15 | ---- | 4.2 | 0.0 |
| Yankton | 1,203 | 49 | 57 | 28.70 | 30.05 | −.03 | 33.0 | −2.3 | 62 | 25 | 42 | 7 | 17 | 24 | 35 | ---- | ---- | ---- | 0.65 | −0.1 | 7 | 5,355 | nw. | 33 | nw. | 11 | 2 | 11 | 17 | 7.0 | 2.8 | 0.0 |

TABLE 1.—*Climatological data for Weather Bureau stations, November, 1927*—Continued

| District and station | Elevation of instruments: Barometer above sea level | Elevation of instruments: Thermometer above ground | Elevation of instruments: Anemometer above ground | Pressure: Station reduced to mean of 24 hours | Pressure: Sea level, reduced to mean of 24 hours | Pressure: Departure from normal | Temperature of the air: Mean max. + mean min. ÷2 | Temperature of the air: Departure from normal | Temperature of the air: Maximum | Temperature of the air: Date | Temperature of the air: Mean maximum | Temperature of the air: Minimum | Temperature of the air: Date | Temperature of the air: Mean minimum | Temperature of the air: Greatest daily range | Mean wet thermometer | Mean temperature of the dew-point | Mean relative humidity | Precipitation: Total | Precipitation: Departure from normal | Precipitation: Days with 0.01, or more | Wind: Total movement | Wind: Prevailing direction | Wind: Maximum velocity: Miles per hour | Wind: Maximum velocity: Direction | Wind: Maximum velocity: Date | Clear days | Partly cloudy days | Cloudy days | Average cloudiness, tenths | Total snowfall | Snow, sleet, and ice on ground at end of month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ft. | Ft. | Ft. | In. | In. | In. | °F. | °F. | °F. | | °F. | °F. | | °F. | °F. | °F. | °F. | % | In. | In. | | Miles | | | | | | | | 0–10 | In. | In. |
| ***Northern Slope*** | | | | | | | 32.9 | +0.2 | | | | | | | | | | 73 | 1.45 | +0.6 | | | | | | | | | | 7.8 | | |
| Billings | 3,140 | 5 | | | | | 32.4 | | 67 | 25 | 42 | 4 | 11 | 22 | 31 | | | | 1.74 | | 12 | | nw. | | | | 6 | 10 | 14 | | 16.1 | 0.0 |
| Havre | 2,505 | 11 | 44 | 27.32 | 30.06 | +.03 | 20.8 | −10.4 | 58 | 3 | 29 | −11 | 22 | 13 | 42 | 19 | 17 | 83 | 1.34 | +0.6 | 17 | 5,204 | e. | 34 | sw. | 23 | 2 | 10 | 18 | 7.7 | 15.7 | 2.8 |
| Helena | 4,110 | 87 | 112 | 25.70 | 29.98 | −.12 | 32.6 | −0.6 | 54 | 2 | 41 | 7 | 14 | 24 | 36 | 29 | 24 | 72 | 1.86 | +1.1 | 12 | 5,047 | sw. | 38 | sw. | 28 | 1 | 6 | 23 | 8.7 | 17.7 | 0.0 |
| Kalispell | 2,973 | 48 | 56 | 26.83 | 29.93 | −.14 | 34.8 | +2.4 | 57 | 3 | 40 | 20 | 14 | 29 | 19 | 32 | 29 | 81 | 2.59 | +0.7 | 16 | 3,196 | nw. | 23 | sw. | 23 | 0 | 7 | 23 | 8.5 | 12.4 | 0.0 |
| Miles City | 2,371 | 48 | 55 | 27.47 | 30.10 | +.03 | 28.4 | −2.5 | 60 | 3 | 37 | 2 | 16 | 20 | 34 | 29 | 21 | 78 | 1.37 | +0.8 | 13 | 2,981 | ne. | 30 | nw. | 3 | 4 | 4 | 22 | 8.0 | 11.1 | 1.0 |
| Rapid City | 3,259 | 50 | 58 | 26.58 | 30.09 | +.01 | 32.8 | −3.1 | 69 | 10 | 42 | 10 | 18 | 23 | 41 | 27 | 21 | 67 | 1.04 | +0.6 | 10 | 4,764 | w. | 34 | nw. | 10 | 2 | 9 | 19 | 8.0 | 11.4 | 0.0 |
| Cheyenne | 6,088 | 84 | 101 | 23.94 | 29.97 | −.10 | 39.4 | +4.6 | 67 | 10 | 50 | 9 | 30 | 29 | 45 | 31 | 22 | 55 | 0.64 | +0.2 | 6 | 10,864 | w. | 61 | w. | 2 | 5 | 9 | 16 | 6.9 | 3.9 | 2.4 |
| Lander | 5,372 | 60 | 68 | 24.57 | 29.99 | −.09 | 37.1 | +6.8 | 65 | 4 | 49 | 12 | 23 | 26 | 33 | 31 | 24 | 64 | 0.22 | −0.4 | 2 | 4,352 | sw. | 52 | sw. | 10 | 5 | 14 | 11 | 5.8 | 2.2 | 0.0 |
| Sheridan | 3,790 | 10 | 47 | 26.03 | 30.02 | | 32.8 | | 61 | 25 | 44 | 1 | 11 | 22 | 45 | 28 | 24 | 79 | 2.33 | | 12 | 3,234 | nw. | 41 | nw. | 2 | 3 | 11 | 16 | 7.4 | 13.0 | 0.2 |
| Yellowstone Park | 6,241 | 11 | 48 | 23.80 | 30.01 | −.10 | 32.2 | +2.9 | 51 | 6 | 39 | 9 | 11 | 26 | 26 | 29 | 25 | 75 | 3.74 | +2.3 | 27 | 7,662 | s. | 44 | sw. | 25 | 0 | 5 | 25 | 9.1 | 15.1 | 2.8 |
| North Platte | 2,821 | 11 | 51 | 27.07 | 30.06 | −.02 | 37.9 | +1.3 | 77 | 10 | 49 | 13 | 16 | 26 | 42 | 31 | 26 | 73 | 0.26 | −0.1 | 7 | 4,926 | n. | 32 | n. | 11 | 3 | 8 | 19 | 7.5 | 1.8 | 0.0 |
| ***Middle Slope*** | | | | | | | 46.3 | +3.5 | | | | | | | | | | 61 | 0.41 | −0.6 | | | | | | | | | | 5.4 | | |
| Denver | 5,292 | 106 | 113 | 24.68 | 29.97 | −.09 | 45.9 | +6.1 | 78 | 10 | 59 | 16 | 30 | 33 | 37 | 35 | 23 | 49 | 0.81 | +0.3 | 5 | 5,420 | s. | 33 | w. | 28 | 9 | 16 | 5 | 4.9 | 3.8 | 3.5 |
| Pueblo | 4,685 | 80 | 86 | 25.26 | 29.98 | −.07 | 46.0 | +6.6 | 79 | 10 | 62 | 15 | 30 | 30 | 46 | 35 | 22 | 47 | 0.27 | −0.1 | 1 | 4,801 | nw. | 42 | w. | 11 | 14 | 14 | 2 | 4.1 | 2.7 | 1.0 |
| Concordia | 1,392 | 50 | 58 | 28.56 | 30.06 | −.02 | 41.9 | +0.5 | 80 | 10 | 52 | 17 | 16 | 32 | 37 | 36 | 30 | 69 | 0.26 | −0.7 | 4 | 6,085 | s. | 31 | nw. | 11 | 6 | 7 | 17 | 6.9 | 2.2 | T. |
| Dodge City | 2,509 | 11 | 51 | 27.42 | 30.07 | .00 | 44.6 | +2.0 | 86 | 10 | 58 | 16 | 16 | 31 | 38 | 34 | 27 | 60 | 0.15 | −0.4 | 1 | 6,745 | sw. | 36 | ne. | 29 | 18 | 7 | 5 | 3.4 | 1.5 | 0.1 |
| Wichita | 1,358 | 139 | 158 | 28.59 | 30.05 | −.03 | 46.2 | +1.4 | 77 | 10 | 57 | 22 | 16 | 36 | 41 | 40 | 35 | 71 | 0.32 | −0.9 | 3 | 9,966 | s. | 47 | s. | 10 | 7 | 11 | 12 | 5.8 | 2.3 | 0.5 |
| Broken Arrow | 765 | 11 | 56 | 29.23 | 30.06 | | 51.6 | | 80 | 29 | 62 | 25 | 30 | 41 | 39 | | | | 1.02 | | 7 | 11,550 | s. | 46 | s. | 21 | 5 | 8 | 17 | 7.0 | T. | 0.0 |
| Oklahoma City | 1,214 | 10 | 47 | 28.76 | 30.06 | −.02 | 53.2 | +4.4 | 80 | 4 | 64 | 26 | 16 | 42 | 39 | 46 | 41 | 70 | 0.63 | −1.6 | 6 | 8,940 | s. | 36 | n. | 14 | 10 | 10 | 10 | 5.7 | T. | 0.0 |
| ***Southern Slope*** | | | | | | | 59.2 | +7.5 | | | | | | | | | | 54 | T. | −1.1 | | | | | | | | | | 3.6 | | |
| Abilene | 1,738 | 10 | 52 | 28.24 | 30.05 | −.02 | 61.4 | +7.9 | 85 | 1 | 74 | 30 | 16 | 48 | 37 | 51 | 44 | 61 | T. | −1.2 | 0 | 7,783 | s. | 36 | s. | 14 | 13 | 9 | 8 | 4.2 | 0.0 | 0.0 |
| Amarillo | 3,676 | 10 | 49 | 26.29 | 30.03 | −.02 | 52.6 | +7.1 | 83 | 10 | 67 | 26 | 30 | 38 | 46 | 39 | 28 | 47 | 0.02 | −1.1 | 1 | 5,867 | sw. | 29 | w. | 29 | 17 | 8 | 5 | 3.3 | 0.2 | 0.0 |
| Del Rio | 944 | 64 | 71 | 29.02 | 30.00 | −.05 | 68.4 | +8.4 | 88 | 8 | 78 | 37 | 17 | 58 | 34 | 59 | 53 | 65 | T. | −1.2 | 0 | 6,272 | se. | 32 | nw. | 30 | 14 | 13 | 3 | 3.8 | 0.0 | 0.0 |
| Roswell | 3,566 | 75 | 85 | 26.39 | 30.01 | −.02 | 54.6 | +6.5 | 84 | 10 | 71 | 27 | 17 | 38 | 50 | 41 | 28 | 43 | 0.00 | −0.9 | 0 | 4,735 | s. | 36 | nw. | 29 | 22 | 1 | 7 | 3.1 | 0.0 | 0.0 |
| ***Southern Plateau*** | | | | | | | 53.8 | +4.5 | | | | | | | | | | 53 | 0.19 | −0.4 | | | | | | | | | | 3.0 | | |
| El Paso | 3,778 | 152 | 175 | 26.24 | 30.01 | +.01 | 60.0 | +7.3 | 81 | 13 | 73 | 36 | 17 | 47 | 37 | 45 | 29 | 35 | T. | −0.6 | 0 | 6,417 | w. | 37 | w. | 29 | 21 | 6 | 3 | 2.4 | 0.0 | 0.0 |
| Santa Fe | 7,013 | 38 | 53 | 23.29 | 30.06 | +.03 | 43.1 | +4.2 | 66 | 5 | 54 | 22 | 16 | 32 | 30 | 33 | 24 | 53 | 0.19 | −0.6 | 1 | 4,676 | n. | 36 | nw. | 2 | 16 | 9 | 5 | 3.7 | T. | 0.0 |
| Flagstaff | 6,907 | 10 | 59 | 23.41 | 30.05 | +.03 | 41.5 | +6.9 | 69 | 5 | 56 | 14 | 23 | 27 | 40 | 33 | | 69 | 0.44 | | 2 | 5,749 | nw. | 29 | sw. | 13 | 13 | 16 | 1 | | 0.0 | 0.0 |
| Phoenix | 1,108 | 10 | 82 | 28.83 | 29.99 | +.01 | 63.2 | +3.5 | 85 | 4 | 78 | 37 | 23 | 48 | 39 | 51 | 43 | 56 | 0.14 | −0.8 | 2 | 2,499 | e. | 15 | w. | 22 | 16 | 9 | 5 | 3.2 | 0.0 | 0.0 |
| Yuma | 141 | 9 | 54 | 29.85 | 30.00 | +.02 | 64.8 | +2.4 | 85 | 4 | 78 | 46 | 26 | 52 | 33 | 53 | 44 | 52 | 0.10 | −0.2 | 1 | 3,440 | n. | 23 | n. | 29 | 19 | 7 | 4 | 2.5 | 0.0 | 0.0 |
| Independence | 3,957 | 5 | 25 | 26.01 | 30.08 | +.03 | 50.0 | +2.8 | 81 | 3 | 66 | 20 | 23 | 34 | 40 | 39 | | | 0.51 | +0.2 | 3 | | nw. | | | | 17 | 8 | 5 | | 0.0 | 0.0 |
| ***Middle Plateau*** | | | | | | | 43.8 | +4.6 | | | | | | | | | | 63 | 1.18 | +0.4 | | | | | | | | | | 5.7 | | |
| Reno | 4,532 | 74 | 81 | 25.52 | 30.08 | −.03 | 45.6 | +4.6 | 73 | 4 | 57 | 20 | 23 | 34 | 38 | 38 | 32 | 61 | 0.62 | 0.0 | 5 | 4,581 | w. | 44 | sw. | 20 | 11 | 11 | 8 | 5.0 | 0.0 | 0.0 |
| Tonopah | 6,090 | 12 | 20 | | | | 42.8 | | 65 | 4 | 49 | 20 | 22 | 36 | 22 | 35 | 23 | 46 | 0.01 | | 1 | | se. | | | | | | | | | |
| Winnemucca | 4,344 | 18 | 56 | 25.68 | 30.12 | −.02 | 43.2 | +4.8 | 73 | 4 | 55 | 15 | 23 | 31 | 45 | 37 | 33 | 72 | 1.37 | +0.6 | 13 | 5,083 | sw. | 37 | sw. | 10 | 4 | 10 | 16 | 6.8 | 0.1 | 0.0 |
| Modena | 5,473 | 10 | 43 | 24.67 | 30.06 | −.03 | 41.2 | +4.8 | 68 | 4 | 54 | 12 | 23 | 28 | 38 | 34 | 29 | 68 | 0.69 | +0.1 | 6 | 7,200 | w. | 46 | sw. | 10 | 15 | 8 | 7 | 4.1 | 1.3 | 0.0 |
| Salt Lake City | 4,360 | 163 | 203 | 25.66 | 30.06 | −.06 | 46.8 | +5.7 | 69 | 4 | 55 | 26 | 23 | 39 | 26 | 39 | 31 | 58 | 2.69 | +1.3 | 9 | 5,091 | s. | 40 | nw. | 10 | 6 | 3 | 21 | 7.4 | T. | 0.0 |
| Grand Junction | 4,602 | 60 | 68 | 25.44 | 30.07 | −.01 | 42.4 | +3.1 | 68 | 9 | 53 | 22 | 25 | 32 | 34 | 36 | 31 | 70 | 0.52 | 0.0 | 8 | 2,958 | se. | 36 | sw. | 6 | 8 | 15 | 7 | 5.1 | T. | 0.0 |
| ***Northern Plateau*** | | | | | | | 43.7 | +4.3 | | | | | | | | | | 75 | 2.96 | +1.6 | | | | | | | | | | 8.6 | | |
| Baker | 3,471 | 48 | 53 | 26.43 | 30.05 | −.11 | 40.3 | +4.3 | 63 | 4 | 48 | 20 | 1 | 33 | 24 | 37 | 33 | 76 | 1.88 | +0.7 | 20 | 3,495 | se. | 21 | sw. | 28 | 1 | 5 | 24 | 8.9 | 4.3 | 0.6 |
| Boise | 2,739 | 78 | 86 | 27.20 | 30.08 | −.09 | 45.8 | +4.8 | 69 | 4 | 53 | 24 | 22 | 39 | 27 | 41 | 37 | 74 | 3.25 | +2.4 | 17 | 3,532 | se. | 27 | s. | 9 | 5 | 5 | 20 | 7.5 | T. | 0.0 |
| Lewiston | 757 | 40 | 48 | 29.14 | 29.96 | −.16 | 46.1 | +4.7 | 62 | 25 | 52 | 30 | 22 | 40 | 22 | | | | 3.35 | +2.0 | 23 | 2,302 | e. | 35 | w. | 28 | 0 | 7 | 23 | 8.8 | 0.0 | 0.0 |
| Pocatello | 4,477 | 60 | 68 | 25.48 | 30.03 | −.11 | 42.8 | +6.1 | 66 | 5 | 49 | 22 | 23 | 36 | 21 | 37 | 31 | 66 | 1.92 | +1.4 | 13 | 8,208 | sw. | 44 | sw. | 10 | 0 | 11 | 19 | 8.4 | 1.5 | 0.0 |
| Spokane | 1,929 | 101 | 110 | 27.89 | 29.97 | −.13 | 39.7 | +1.2 | 54 | 19 | 45 | 30 | 26 | 34 | 17 | 38 | 35 | 84 | 4.32 | +2.2 | 18 | 4,303 | s. | 31 | sw. | 24 | 0 | 4 | 26 | 8.9 | 4.4 | 0.0 |
| Walla Walla | 991 | 57 | 65 | 28.91 | 29.99 | −.14 | 47.4 | +4.6 | 67 | 3 | 53 | 34 | 12 | 42 | 23 | 44 | 40 | 76 | 3.19 | +1.1 | 19 | 3,745 | s. | 26 | w. | 28 | 1 | 7 | 22 | 8.8 | 0.0 | 0.0 |
| ***North Pacific Coast Region*** | | | | | | | 47.9 | +1.7 | | | | | | | | | | 85 | 8.06 | +1.4 | | | | | | | | | | 8.8 | | |
| North Head | 211 | 11 | 56 | 29.70 | 29.94 | −.11 | 48.4 | +0.2 | 55 | 3 | 52 | 35 | 26 | 45 | 15 | 47 | 45 | 91 | 10.88 | +3.4 | 29 | 13,618 | se. | 72 | s. | 23 | 0 | 2 | 28 | 9.5 | 0.0 | 0.0 |
| Port Angeles | 29 | 8 | 53 | | 29.96 | | 43.8 | | 57 | 19 | 49 | 31 | 26 | 39 | 18 | | | | 4.47 | 0.0 | 27 | 4,213 | sw. | 35 | sw. | 25 | 0 | 4 | 26 | | 0.0 | 0.0 |
| Seattle | 125 | 215 | 250 | 29.83 | 29.96 | −.08 | 46.5 | +0.9 | 57 | 16 | 50 | 35 | 26 | 43 | 14 | 44 | 42 | 86 | 5.86 | +0.5 | 26 | 8,015 | s. | 41 | s. | 13 | 0 | 4 | 26 | 9.2 | 0.0 | 0.0 |
| Tacoma | 194 | 172 | 201 | 29.77 | 29.98 | −.06 | 46.4 | +1.8 | 59 | 16 | 51 | 32 | 26 | 42 | 21 | | | | 7.95 | +1.4 | 28 | 6,181 | s. | 34 | sw. | 24 | 0 | 4 | 26 | 9.3 | 0.0 | 0.0 |
| Tatoosh Island | 86 | 9 | 53 | 29.81 | 29.91 | −.06 | 45.8 | −0.1 | 54 | 3 | 49 | 38 | 26 | 43 | 12 | 44 | 43 | 90 | 14.09 | +2.0 | 28 | 14,507 | e. | 79 | s. | 22 | 1 | 1 | 28 | 9.1 | 0.0 | 0.0 |
| Yakima | 1,071 | 5 | | | | | 42.2 | | 70 | 3 | 53 | 20 | 22 | 31 | 39 | 38 | | 83 | 1.43 | | 13 | | ne. | | | | 2 | 13 | 15 | 7.1 | 1.2 | T. |
| Medford | 1,425 | 4 | | [1]28.54 | [1]30.06 | | 47.2 | | 69 | 3 | 55 | 27 | 1 | 39 | 30 | 44 | 41 | 82 | 4.42 | | 18 | | n. | | | | 3 | 5 | 22 | 8.3 | 0.0 | 0.0 |
| Portland, Oreg | 153 | 68 | 106 | 29.85 | 30.01 | −.09 | 49.8 | +3.0 | 70 | 3 | 55 | 34 | 10 | 45 | 18 | 47 | 45 | 84 | 7.99 | +1.6 | 24 | 4,781 | sw. | 26 | s. | 24 | 0 | 1 | 29 | 9.6 | 0.0 | 0.0 |
| Roseburg | 510 | 75 | 99 | 29.51 | 30.06 | −.06 | 50.6 | +4.7 | 71 | 2 | 58 | 31 | 10 | 44 | 4 | 48 | 45 | 82 | 5.31 | +0.9 | 19 | 2,544 | s. | 24 | sw. | 24 | 0 | 10 | 20 | 8.3 | 0.0 | 0.0 |
| ***Middle Pacific Coast Region*** | | | | | | | 55.0 | +1.2 | | | | | | | | | | 80 | 3.24 | +0.3 | | | | | | | | | | 5.8 | | |
| Eureka | 62 | 73 | 80 | 30.04 | 30.11 | .00 | 53.3 | +2.2 | 66 | 15 | 50 | 35 | 22 | 43 | 21 | 51 | 48 | 84 | 5.89 | +0.2 | 16 | 4,229 | se. | 27 | se. | 9 | 5 | 5 | 20 | 7.6 | 0.0 | 0.0 |
| Red Bluff | 332 | 50 | 56 | 29.73 | 30.10 | −.01 | 53.0 | −0.8 | 85 | 2 | 61 | 30 | 23 | 45 | 37 | 50 | 46 | 79 | 4.06 | +0.9 | 13 | 3,833 | se. | 26 | se. | 9 | 9 | 8 | 13 | 5.8 | 0.0 | 0.0 |
| Sacramento | 69 | 106 | 117 | 30.03 | 30.10 | +.01 | 54.4 | +0.8 | 77 | 4 | 61 | 35 | 23 | 48 | 28 | 51 | 47 | 79 | 1.81 | −0.3 | 9 | 4,825 | se. | 40 | se. | 9 | 11 | 6 | 13 | 5.4 | 0.0 | 0.0 |
| San Francisco | 155 | 208 | 243 | 29.93 | 30.10 | +.01 | 58.1 | +1.8 | 77 | 3 | 64 | 44 | 23 | 52 | 19 | 54 | 50 | 78 | 3.18 | +0.7 | 12 | 4,682 | nw. | 30 | se. | 9 | 10 | 10 | 10 | 5.4 | 0.0 | 0.0 |
| San Jose | 141 | 12 | 110 | 29.96 | 30.11 | | 56.2 | +1.8 | 81 | 3 | 66 | 32 | 23 | 46 | 36 | | | | 1.25 | −0.2 | 8 | 3,952 | nw. | 37 | se. | 9 | 11 | 12 | 7 | 4.8 | 0.0 | 0.0 |
| ***South Pacific Coast Region*** | | | | | | | 61.2 | +2.9 | | | | | | | | | | 70 | 0.57 | −0.6 | | | | | | | | | | 4.4 | | |
| Fresno | 327 | 89 | 98 | 29.76 | 30.12 | +.06 | 54.5 | +0.3 | 80 | 4 | 63 | 34 | 24 | 46 | 28 | 50 | 47 | 80 | 1.05 | 0.0 | 8 | 3,034 | nw. | 23 | nw. | 20 | 11 | 7 | 12 | 5.7 | 0.0 | 0.0 |
| Los Angeles | 338 | 159 | 191 | 29.68 | 30.04 | +.03 | 65.8 | +4.9 | 90 | 17 | 75 | 49 | 22 | 57 | 28 | 54 | 46 | 57 | 0.61 | −0.9 | 4 | 3,303 | ne. | 13 | ne. | 18 | 16 | 7 | 7 | 3.6 | 0.0 | 0.0 |
| San Diego | 87 | 62 | 70 | 29.93 | 30.02 | .00 | 63.3 | +3.6 | 83 | 17 | 71 | 50 | 23 | 55 | 25 | 50 | 52 | 74 | 0.05 | −0.8 | 2 | 3,159 | nw. | 25 | sw. | 5 | 14 | 10 | 6 | 3.9 | 0.0 | 0.0 |
| ***West Indies*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| San Juan, P. R. | 82 | 9 | 54 | 29.80 | 29.88 | | 78.2 | −0.2 | 90 | 3 | 83 | 70 | 10 | 73 | 17 | | | | 11.99 | +5.1 | 25 | 9,778 | e. | 45 | e. | 13 | 3 | 16 | 11 | 6.5 | 0.0 | 0.0 |
| ***Panama Canal*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Balboa Heights | 118 | 7 | 97 | 29.70 | 29.82 | .02 | 80.2 | +1.1 | 90 | 9 | 80 | 72 | 14 | 74 | 16 | 75 | 75 | | 5.82 | −4.1 | 21 | 4,561 | nw. | 23 | nw. | 27 | 0 | 13 | 17 | 7.4 | 0.0 | 0.0 |
| Colon | 38 | 7 | 97 | 29.78 | 29.82 | .02 | 80.0 | +0.7 | 89 | 1 | 85 | 72 | 12 | 75 | 16 | 76 | 75 | | 28.35 | +6.9 | 29 | 6,215 | w. | 48 | nw. | 25 | 0 | 5 | 25 | 8.8 | 0.0 | 0.0 |
| ***Alaska*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Juneau | 80 | 11 | 54 | [1]29.77 | [1]29.86 | | 27.9 | | 43 | 1 | 32 | 6 | 28 | 24 | 17 | 25 | 15 | 58 | 3.57 | | 15 | 7,548 | e. | 46 | e. | 8 | 13 | 2 | 15 | 5.2 | 21.8 | 10.2 |
| ***Hawaiian Islands*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Honolulu | 38 | 86 | 100 | [1]29.95 | [1]29.99 | | 75.7 | | 83 | 22 | 80 | 67 | 16 | 71 | 14 | 69 | 66 | 75 | 6.82 | +3.0 | 18 | 6,707 | e. | 32 | ne. | 17 | 7 | 11 | 12 | 6.9 | 0.0 | .00 |

[1] Pressure not corrected to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, November, 1927*

| Station | Altitude above mean sea level Jan. 1, 1919 | Pressure | | | Temperature of the air | | | | | | Precipitation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Station reduced to mean of 24 hours | Sea level reduced to mean of 24 hours | Departure from normal | Mean max. + mean min. ÷ 2 | Departure from normal | Mean maximum | Mean minimum | Highest | Lowest | Total | Departure from normal | Total snowfall |
| | *Feet* | *Inches* | *Inches* | *Inches* | *° F.* | *° F.* | *° F.* | *° F.* | *° F.* | *° F.* | *Inches* | *Inches* | *Inches* |
| Cape Race, N. F. | 99 | | | | 38.7 | | 45.6 | 31.8 | 55 | 14 | 3.67 | | 0.0 |
| Sydney, C. B. I. | 48 | | | | | | | | | | | | |
| Halifax, N. S. | 88 | | | | | | | | | | | | |
| Yarmouth, N. S. | 65 | | | | | | | | | | | | |
| Charlottetown, P. E. I. | 38 | | | | | | | | | | | | |
| Chatham, N. B. | 28 | | | | | | | | | | | | |
| Father Point, Que. | 20 | 29.96 | 29.98 | +0.02 | 32.4 | +3.5 | 38.9 | 25.9 | 69 | 8 | 5.54 | +2.43 | 5.0 |
| Quebec, Que. | 296 | 29.69 | 30.03 | +.01 | 33.9 | +4.9 | 39.6 | 28.3 | 67 | 12 | 8.95 | +5.19 | 7.8 |
| Doucet, Que. | 1,236 | | | | | | | | | | | | |
| Montreal, Que. | 187 | 29.78 | 29.99 | −.04 | 36.3 | +4.5 | 41.8 | 30.8 | 67 | 19 | 12.04 | +8.30 | 6.9 |
| Ottawa, Ont. | 236 | 29.76 | 30.03 | +.01 | 35.9 | +4.2 | 42.6 | 29.3 | 69 | 18 | 7.92 | +5.38 | 11.7 |
| Kingston, Ont. | 285 | 29.71 | 30.03 | −.01 | 39.7 | +4.7 | 45.3 | 34.1 | 62 | 18 | 6.75 | +3.51 | 0.9 |
| Toronto, Ont. | 379 | 29.61 | 30.03 | −.01 | 40.9 | +5.3 | 47.7 | 34.2 | 69 | 22 | 4.37 | +1.23 | 2.3 |
| Cochrane, Ont. | 930 | | | | | | | | | | | | |
| White River, Ont. | 1,244 | 28.62 | 29.98 | .00 | 19.2 | −1.3 | 26.7 | 11.6 | 51 | −16 | 3.13 | +1.28 | 14.6 |
| London, Ont. | 808 | | | | 39.8 | | 46.6 | 33.1 | 68 | 19 | 7.23 | | 13.8 |
| Southampton, Ont. | 656 | 29.28 | 30.01 | −.01 | 38.7 | +3.7 | 46.5 | 30.9 | 70 | 19 | 4.28 | +0.58 | 13.6 |
| Parry Sound, Ont. | 688 | 29.29 | 30.00 | −.01 | 34.3 | +2.2 | 41.3 | 27.4 | 66 | 12 | 4.52 | +0.15 | 8.3 |
| Port Arthur, Ont. | 644 | 29.32 | 30.05 | +.05 | 24.7 | +0.7 | 30.9 | 18.6 | 48 | −3 | 1.20 | −0.13 | 8.2 |
| Winnipeg, Man. | 760 | | | | | | | | | | | | |
| Minnedosa, Man. | 1,690 | 28.18 | 30.10 | +.06 | 11.8 | −5.5 | 18.1 | 5.6 | 38 | −22 | 1.07 | +0.07 | 10.7 |
| Le Pas, Man. | 860 | | | | 9.5 | | 18.9 | 0.2 | 47 | −24 | 0.78 | | 7.8 |
| Qu'Appelle, Sask. | 2,115 | 27.70 | 30.06 | +.06 | 11.2 | −7.6 | 18.3 | 4.1 | 46 | −21 | 1.80 | +0.91 | 18.0 |
| Moose Jaw, Sask. | 1,759 | | | | 14.6 | | 22.2 | 7.1 | 53 | −15 | 1.52 | | 15.2 |
| Swift Current, Sask. | 2,392 | 27.36 | 30.01 | −.01 | 15.7 | −7.5 | 23.6 | 7.8 | 54 | −15 | 1.35 | +0.66 | 13.5 |
| Medicine Hat, Alb. | 2,144 | | | | | | | | | | | | |
| Calgary, Alb. | 3,428 | | | | | | | | | | | | |
| Banff, Alb. | 4,521 | | | | | | | | | | | | |
| Prince Albert, Sask. | 1,450 | 28.48 | 30.15 | +.12 | 8.4 | −7.0 | 15.9 | 1.0 | 47 | −27 | 0.69 | −0.14 | 6.9 |
| Battleford, Sask. | 1,592 | 28.28 | 30.12 | +.10 | 9.1 | −7.2 | 17.6 | 0.6 | 50 | −28 | 0.42 | −0.16 | 4.2 |
| Edmonton, Alb. | 2,150 | | | | | | | | | | | | |
| Kamloops, B. C. | 1,262 | | | | | | | | | | | | |
| Victoria, B. C. | 230 | 29.69 | 29.95 | −.04 | 44.1 | +0.9 | 47.7 | 40.5 | 58 | 35 | 5.98 | −0.99 | 0.0 |
| Barkerville, B. C. | 4,180 | | | | | | | | | | | | |
| Estevan Point, B. C. | 20 | | | | | | | | | | | | |
| Prince Rupert, B. C. | 170 | | | | | | | | | | | | |
| Hamilton, Ber. | 151 | 30.05 | 30.21 | +.16 | 60.4 | +0.7 | 76.0 | 62.8 | 81 | 59 | 1.94 | −2.44 | 0.0 |

## LATE REPORTS FOR SEPTEMBER, 1927

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kamloops, B. C. | 1,262 | 28.64 | 29.92 | −.05 | 58.6 | +1.2 | 67.7 | 49.5 | 76 | 40 | 1.50 | +0.65 | 0.0 |

## LATE REPORTS FOR OCTOBER, 1927

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cape Race, N. F. | 99 | | | | 46.3 | | 53.2 | 39.5 | 61 | 27 | 1.88 | | 0.0 |
| Sydney, C. B. I. | 48 | 29.86 | 29.91 | −0.05 | 51.6 | +5.1 | 57.8 | 45.5 | 75 | 33 | 6.70 | +2.01 | 0.0 |
| Halifax, N. S. | 88 | 29.69 | 29.79 | −.21 | 50.8 | +3.6 | 56.6 | 45.1 | 74 | 30 | 6.86 | +1.31 | 0.0 |
| Yarmouth, N. S. | 65 | 29.82 | 29.89 | −.13 | 51.0 | +3.4 | 57.3 | 44.8 | 73 | 27 | 4.65 | +0.53 | 0.0 |
| Charlottetown, P. E. I. | 38 | 29.82 | 29.86 | −.10 | 51.2 | +4.7 | 56.4 | 45.9 | 74 | 33 | 5.35 | +0.45 | 0.4 |
| Chatham, N. B. | 28 | 29.80 | 29.83 | −.13 | 47.3 | +4.3 | 55.3 | 39.3 | 70 | 25 | 5.96 | +2.10 | 0.0 |
| Medicine Hat, Alb. | 2,144 | 27.56 | 29.82 | −.15 | 50.4 | +5.6 | 61.4 | 39.4 | 82 | 28 | 0.70 | +0.12 | 0.1 |
| Calgary, Alb. | 3,428 | 26.34 | 29.91 | −.04 | 44.2 | +4.1 | 56.4 | 32.0 | 76 | 16 | 0.99 | +0.51 | 0.0 |
| Banff, Alb. | 4,521 | 25.30 | 29.89 | −.06 | 39.9 | +0.6 | 48.1 | 31.7 | 69 | 18 | 1.48 | +0.46 | 2.4 |
| Edmonton, Alb. | 2,150 | 27.54 | 29.83 | −.10 | 40.4 | −0.7 | 50.8 | 30.1 | 69 | 16 | 0.26 | −0.44 | 0.9 |
| Kamloops, B. C. | 1,262 | 28.68 | 29.96 | +.02 | 47.2 | +0.2 | 55.0 | 39.4 | 73 | 29 | 1.40 | +0.88 | T. |
| Barkerville, B. C. | 4,180 | 25.55 | 29.87 | −.07 | 35.5 | −4.2 | 41.8 | 29.3 | 53 | 17 | 7.00 | +4.30 | 42.1 |
| Estevan Point, B. C. | 20 | | | | 48.8 | | 54.3 | 43.3 | 59 | 32 | 14.24 | | 0.0 |
| Prince Rupert, B. C. | 170 | | | | 46.0 | | 52.2 | 39.9 | 60 | 29 | 14.53 | | 0.0 |

Chart I. Tracks of Centers of Anticyclones, November, 1927. (Inset) Departure of Monthly Mean Pressure from Normal
(Plotted by A. J. DeMars)

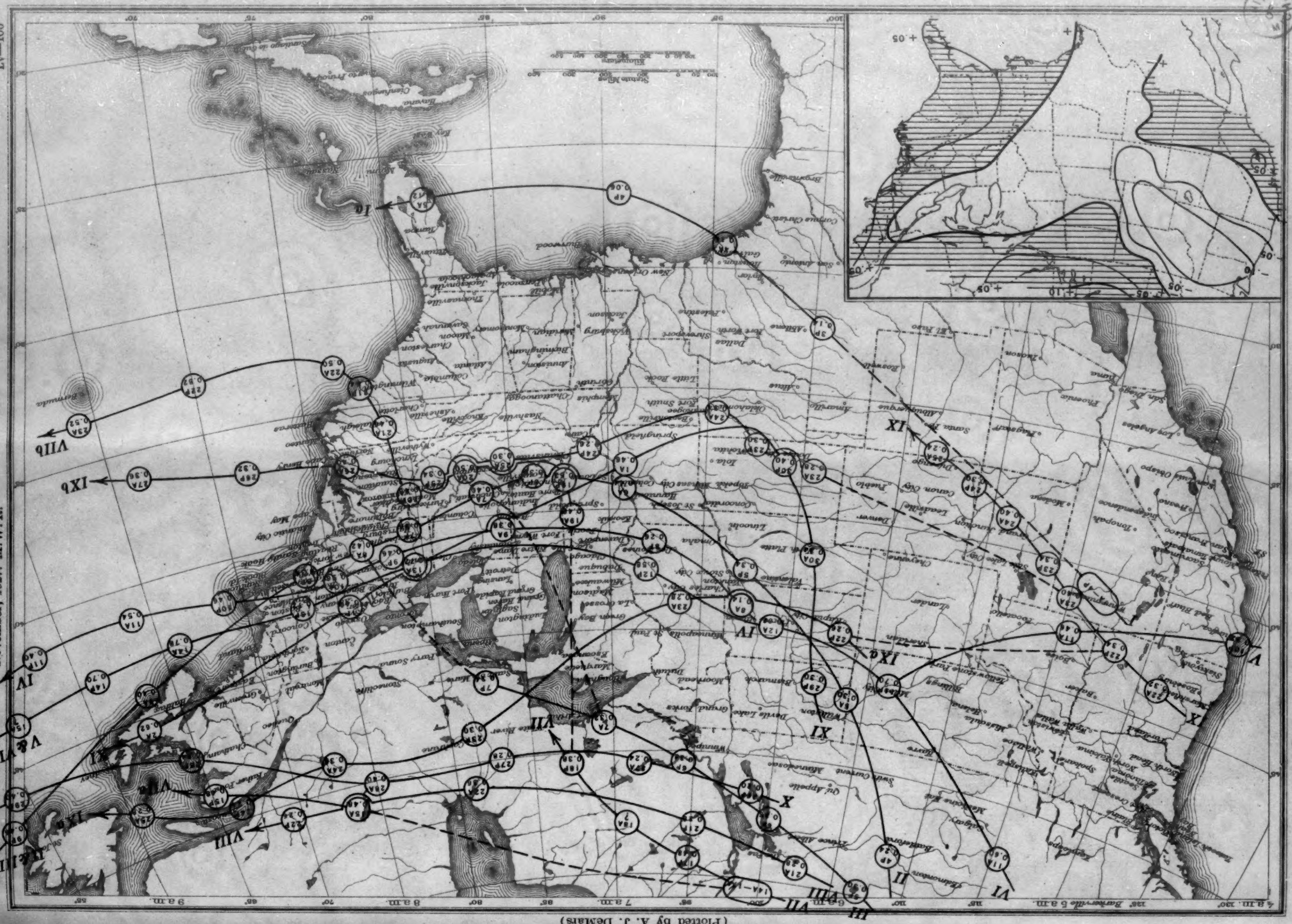
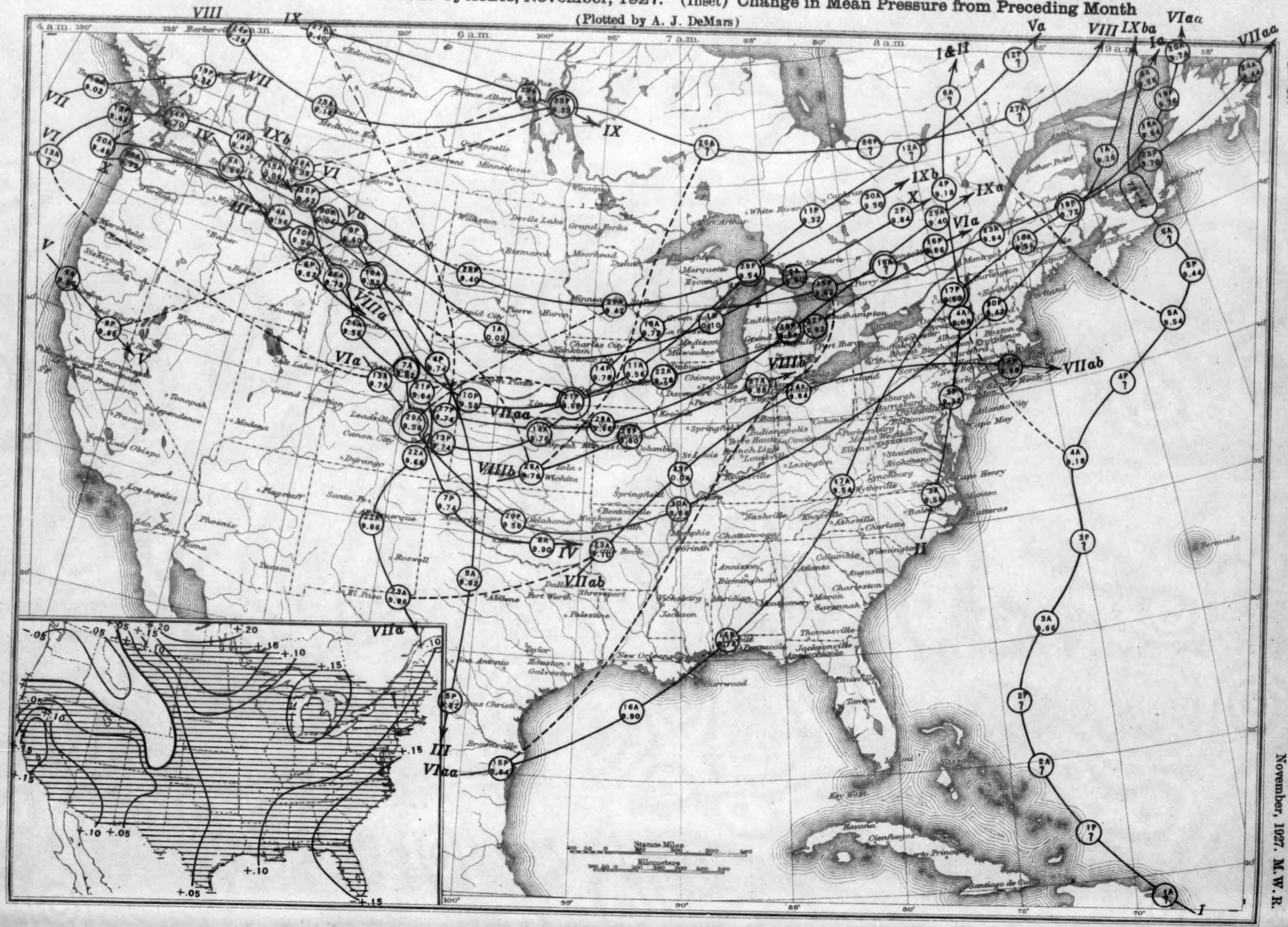


**Chart I. Tracks of Centers of Anticyclones, November, 1927. (Inset) Departure of Monthly Mean Pressure from Normal**

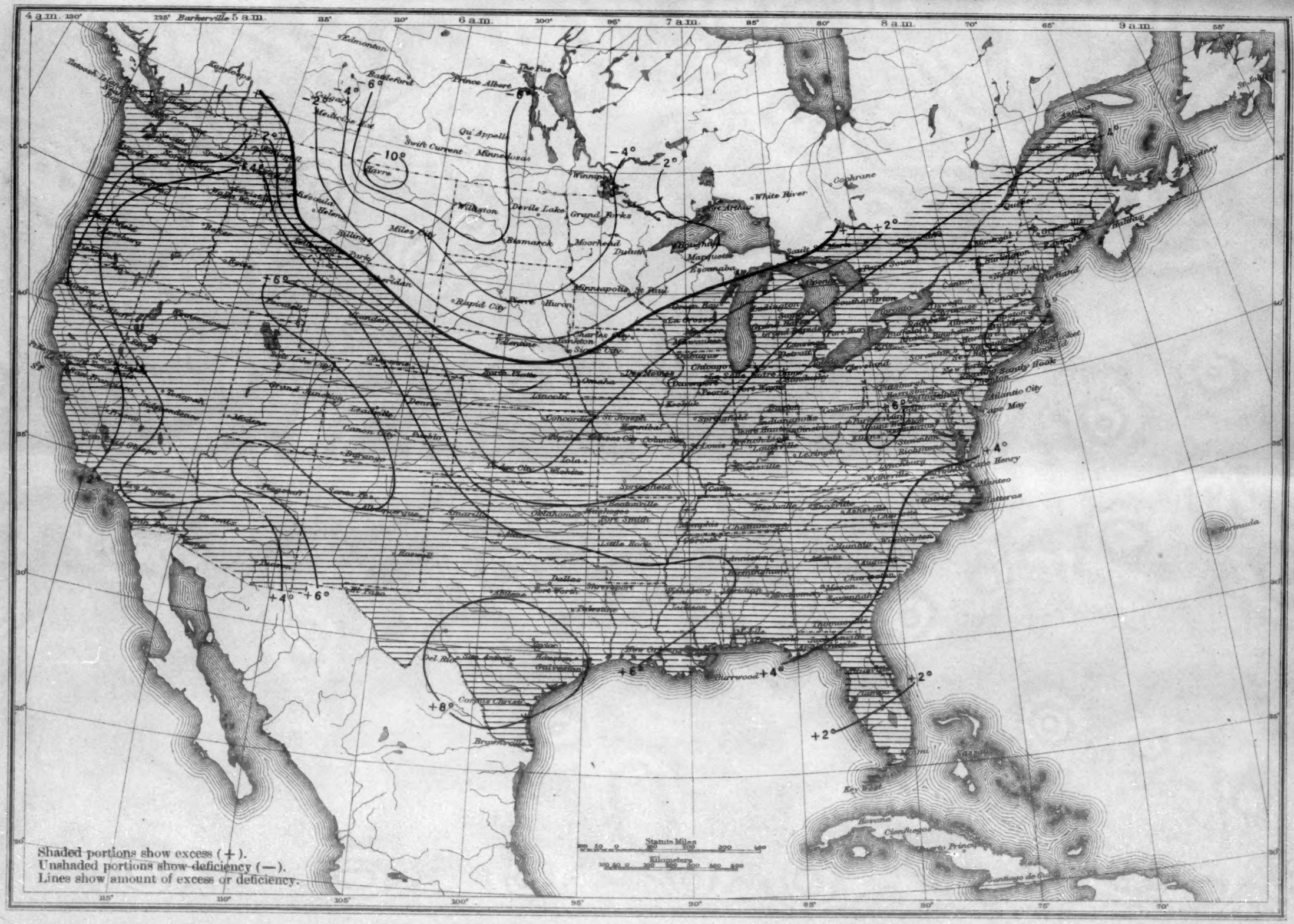
(Plotted by A. J. DeMars)

**Chart II. Tracks of Centers of Cyclones, November, 1927.** (Inset) **Change in Mean Pressure from Preceding Month**

(Plotted by A. J. DeMars)


VIII
IX
VII
VI
X
V
IV
III
II
I
VIIIa
VIa
Va
VIIaa
VIIIb
IXb
IXa
VIIab
VIIa
VIaa
I & II
IXba
Ia
Edmonton
Battleford
Prince Albert
Medicine Hat
Swift Current
Minnedosa
Winnipeg
Devils Lake
Grand Forks
Williston
Bismarck
Moorhead
Dulut
Rapid City
Pierre
Huron
Minneapolis
Charles City
Yankton
Madison
Milwaukee
Chicago
Omaha
Salt Lake City
Grand Junction
Denver
Leadville
Canon City
Topeka
Kansas City
Wichita
Lola
Oklahoma
Fort Smith
Springfield
Bentonville
Memphis
Nashville
Knoxville
Asheville
Charlotte
Chattanooga
Corinth
Jackson
Vicksburg
Meridian
Montgomery
Atlanta
Columbus
Augusta
Savannah
Charleston
Wilmington
Raleigh
Hatteras
Annisto
Birmingham
Dallas
Fort Worth
Shreveport
Abilene
Palestine
Taylor
San Antonio
Houston
Galveston
Corpus Christi
Brownsville
New Orleans
Pensacola
Jacksonville
Tampa
Miami
Nassau
Key West
Havana
Cienfuegos
Santiago de Cuba
Bermuda
Sydney
Father Point
Quebec
Montreal
Ottawa
Toronto
Buffalo
Rochester
Albany
Boston
Providence
Portland
Burlington
Detroit
Cleveland
Toledo
Columbus
Indianapolis
Cincinnati
Louisville
Lexington
Pittsburgh
Harrisburg
Philadelphia
Baltimore
Washington
Atlantic City
Cape May
Trenton
New York
Scranton
Buffalo
Erie
Port Huron
Sault Ste. Marie
Marquette
Escanaba
Duluth
Minneapolis
Moorhead
Grand Forks
Devils Lake
Williston
Bismarck
Dickinson
Miles City
Billings
Havre
Great Falls
Helena
Butte
Spokane
Seattle
Tacoma
Portland
Walla Walla
Boise
Pocatello
Salt Lake City
Grand Junction
Denver
Pueblo
Colorado Springs
Amarillo
Dodge City
Wichita
Oklahoma
Fort Smith
Little Rock
Memphis
Vicksburg
Shreveport
Fort Worth
Dallas

## Chart III. Departure (°F.) of the Mean Temperature from the Normal, November, 1927


4 a.m.
5 a.m.
6 a.m.
7 a.m.
8 a.m.
9 a.m.
Barkerville
Edmonton
Kamloops
Battleford
Prince Albert
The Pas
Calgary
Medicine Hat
Qu'Appelle
Swift Current
Minnedosa
Winnipeg
Havre
Wilmston
Devils Lake
Grand Forks
Bismarck
Moorhead
Duluth
Miles City
Billings
Helena
Missoula
Rapid City
Pierre
Huron
Minneapolis
St. Paul
Sheridan
Yellowstone Park
Boise
Reno
Salt Lake City
Grand Junction
Denver
Leadville
Canon City
Pueblo
Trinidad
Albuquerque
Amarillo
Oklahoma
Fort Smith
Little Rock
Memphis
Chattanooga
Dallas
Fort Worth
Shreveport
Birmingham
Atlanta
Jackson
Meridian
Montgomery
Macon
Columbus
Augusta
Charleston
Wilmington
Raleigh
Norfolk
Hatteras
Bermuda
Cape May
Atlantic City
Sandy Hook
Block Id.
Portland
Halifax
Sydney
St. John
Cochrane
White River
Port Arthur
Marquette
Escanaba
Sault Ste. Marie
Parry Sound
Toronto
Kingston
Ogdensburg
Montreal
Quebec
Detroit
Cleveland
Buffalo
Rochester
Syracuse
Albany
Boston
Portland
Chicago
Milwaukee
La Crosse
Green Bay
Duluth
Omaha
Des Moines
Davenport
Peoria
Keokuk
Lincoln
Concordia
St. Joseph
Hannibal
Topeka
Kansas City
Springfield
Indianapolis
Columbus
Louisville
Lexington
Cincinnati
Evansville
Terre Haute
Fort Wayne
Toledo
South Bend
Grand Rapids
Lansing
Saginaw
Bay City
Port Huron
Flint
Detroit
Ann Arbor
Jackson
Battle Creek
Kalamazoo
Grand Haven
Muskegon
Milwaukee
Madison
La Crosse
Green Bay
Marquette
Escanaba
Sault Ste. Marie
Parry Sound
Toronto
Kingston
Ogdensburg
Montreal
Quebec
Halifax
Sydney
St. John
Portland
Boston
Albany
Syracuse
Rochester
Buffalo
Cleveland
Detroit
Chicago
Milwaukee
Minneapolis
St. Paul

## Chart IV. Total Precipitation, Inches, November, 1927. (Inset) Departure of Precipitation from Normal

## Chart V. Percentage of Clear Sky between Sunrise and Sunset, November, 1927

Chart V. Percentage of Clear Sky between Sunrise and Sunset, November, 1927

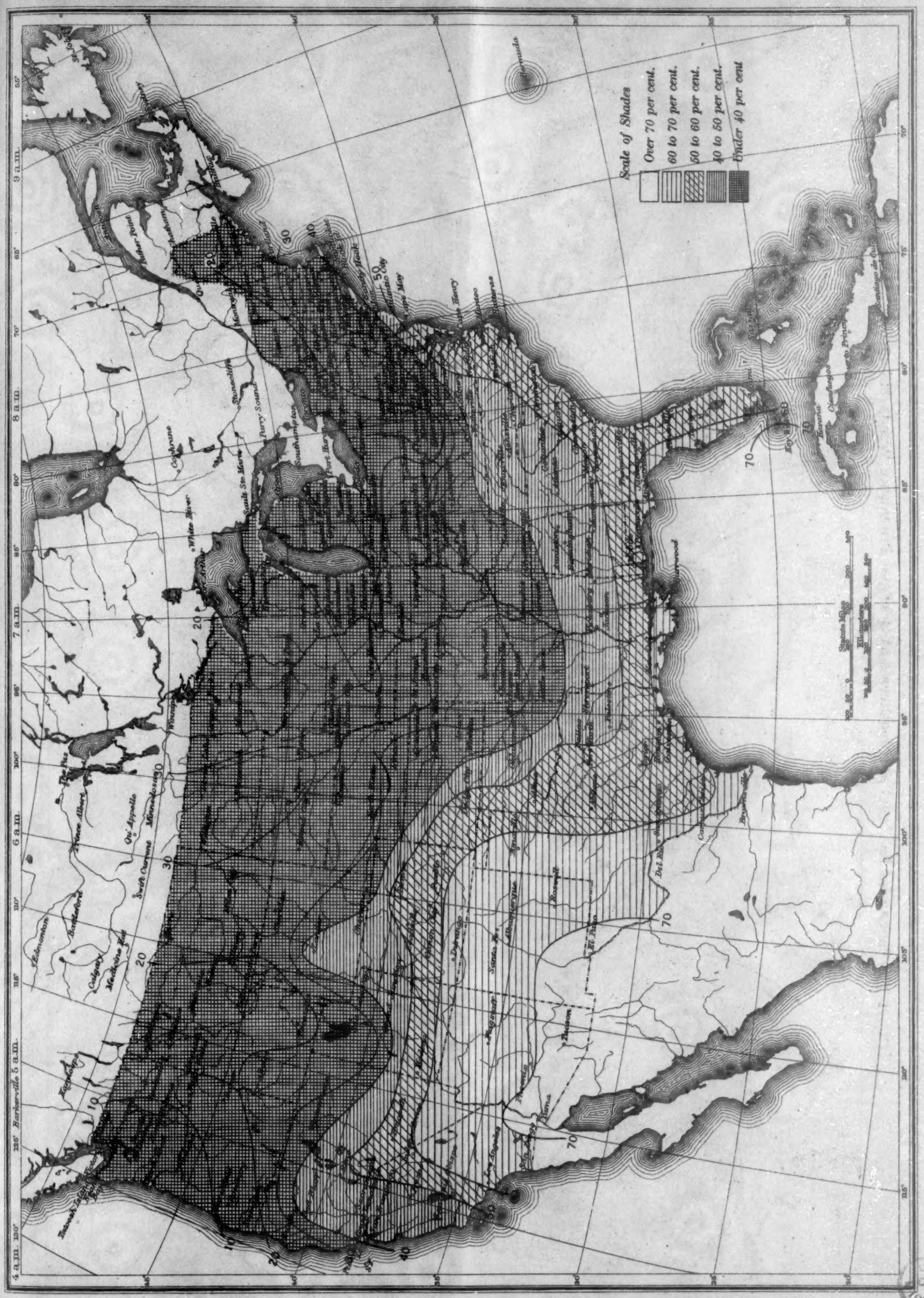

Scale of Shades
Over 70 per cent.
60 to 70 per cent.
50 to 60 per cent.
40 to 50 per cent.
Under 40 per cent
Bermuda
Prince Albert
Edmonton
Calgary
Medicine Hat
Qu'Appelle
Moosejaw
Winnipeg
Regina
Swift Current
Brandon
Portage la Prairie
Kamloops
Nelson
Rossland
Spokane
Walla Walla
Pendleton
Baker
Boise
Pocatello
Salt Lake City
Grand Junction
Durango
Santa Fe
Albuquerque
El Paso
Tucson
Phoenix
Yuma
Roseburg
Eugene
Portland
Astoria
Seattle
Tatoosh Island
Port Angeles
Victoria
Prince Rupert
Ketchikan
Juneau
Sitka
Dawson
Fort Simpson
Fort Resolution
Fort Smith
Fort Chipewyan
Fort Vermilion
Peace River
Dunvegan
Battleford
Prince Albert
Saskatoon
Swift Current
Moosejaw
Qu'Appelle
Brandon
Winnipeg

**Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, November, 1927**

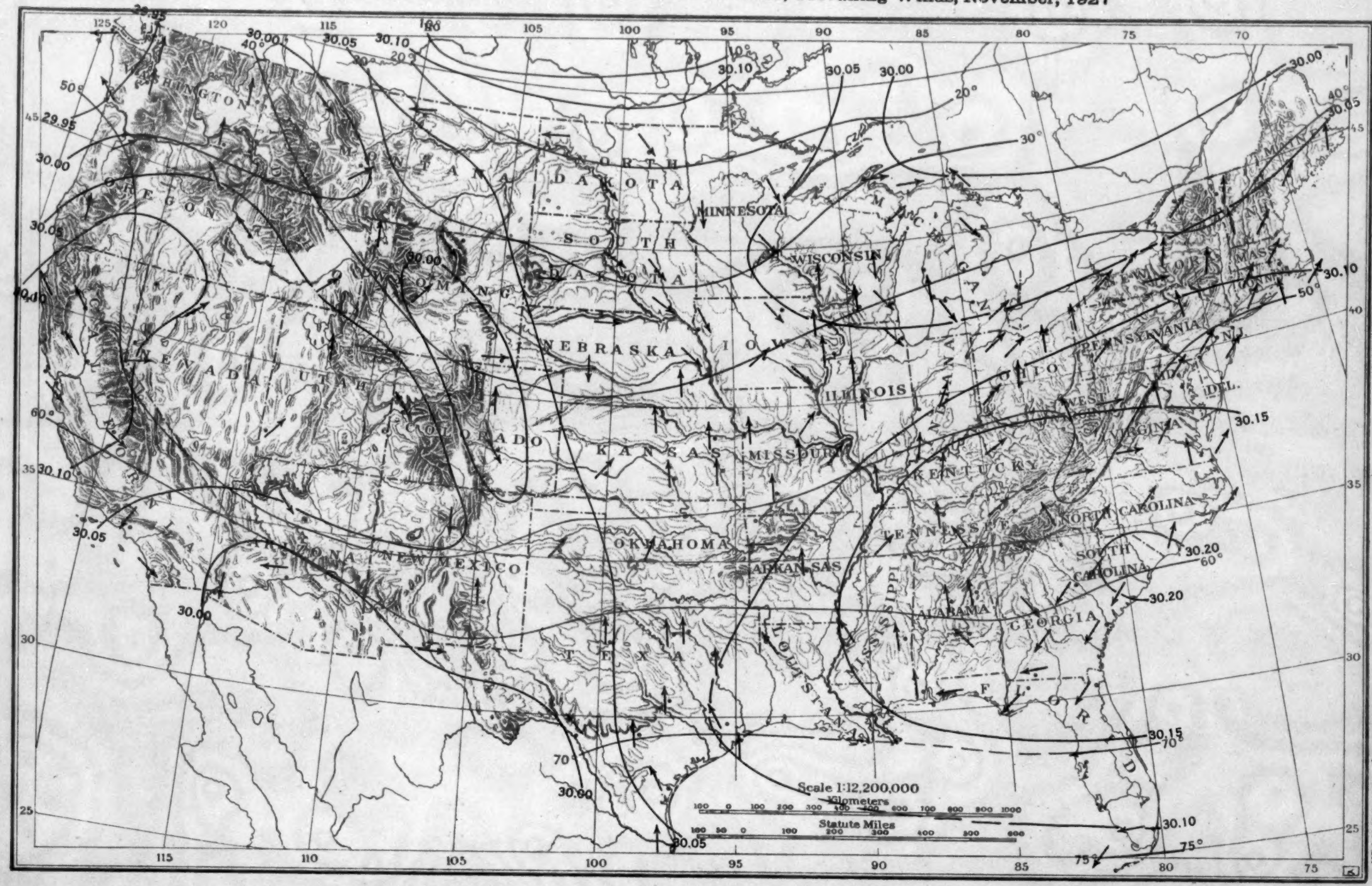





**Chart VII. Total Snowfall, Inches, November, 1927. (Inset) Depth of Snow on Ground at end of Month**

**Chart VII. Total Snowfall, Inches, November, 1927. (Inset) Depth of Snow on Ground at end of Month**

November, 1927. M. W. B.

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Chart VIII. Weather Map of North Atlantic Ocean, November 1, 1927
(Plotted by F. A. Young)

## Chart VIII. Weather Map of North Atlantic Ocean, November 1, 1927

(Plotted by F. A. Young)

Greenwich Mean Noon.

Isobars show corrected barometric readings in inches of mercury.

Arrows fly with the wind.

Number of feathers indicate force, Beaufort scale.

Weather symbols are as follows:

○ clear, ◑ partly cloudy, ● cloudy, • rain, ▲ hail or sleet, ✳ snow, ≡ fog.

Pointed arrows indicate land stations.

Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.



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# Chart IX. Weather Map of North Atlantic Ocean, November 2, 1927

(Plotted by F. A. Young)

Greenwich Mean Noon.

Isobars show corrected barometric readings in inches of mercury.

Arrows fly with the wind.

Number of feathers indicate force, Beaufort scale.

Weather symbols are as follows:

○ clear, ◑ partly cloudy, ● cloudy,
• rain, ▲ hail or sleet, ✳ snow,
≡ fog.

Pointed arrows indicate land stations.

Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.

Arctic Circle

Tropic of Cancer

LV—114

November, 1927. M. W. R.